Heating Piping & Air Conditioning

DECEMBER 1958

Single copy price 75c

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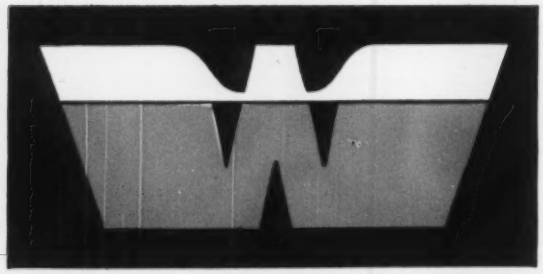
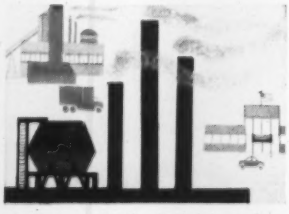


WORTHINGTON

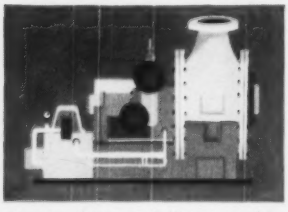
This is our new corporate face... a new symbol of our classic Worthington "wings." This new mark is much easier to see and attracts more attention. But it still represents the qualities and values which have made Worthington and Worthington products outstanding in performance, reliable in operation, trusted in every market place in the world.

This mark is by no means the only change at Worthington. There are many new air conditioning and refrigeration products and developments coming. You can expect brand-new improvements...brand-new, yet backed by the skills and experience of a leader in the air conditioning industry. These products will make news and they will be copied. We know that and expect it. It is part of the record of leadership that has been associated with Worthington for over 118 years. Worthington Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

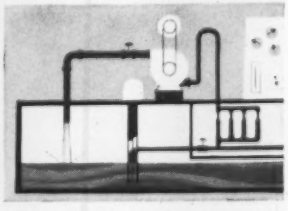
NEW sales organization...serves both direct and distributor sales, is geared to customer needs.



NEW decentralized divisions feature integral application, manufacturing and engineering units.



NEW products and lines . . . include many additions to broad lines of power service equipment.



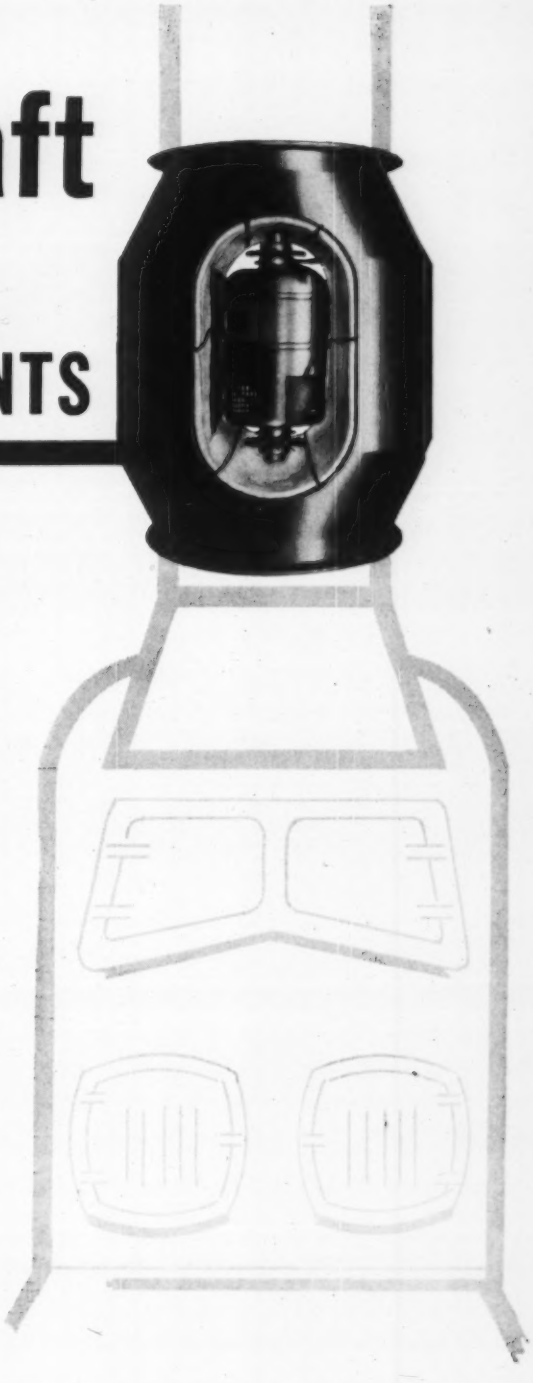
NEW emphasis on research . . . 10 laboratories keep Worthington in leading product-market position.

Regulate draft

ACCORDING TO

BOILER REQUIREMENTS

Remote motor controller changes fan speed from full to 50% reduction



Select the exact amount of draft needed for optimum boiler performance with this 11-step controller for single phase motors.* This controller can be conveniently located anywhere in the boiler room. Provided as standard equipment with a DeBOTHEZAT Induced Draft Bifurcator Fans, the motor speed controller keeps draft in pace with fluctuating boiler loads to conserve fuel.

Space-saving Induced Draft Bifurcators, with 12″ through 36″ fan wheel diameters, are available for high pressure boilers delivering up to 60,000 pounds of steam per hour and low pressure boilers delivering up to 190,000 EDR.

**9-step controller for 3-phase motors also available.*

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OR WRITE FOR COPY

De Bothezat FANS
A DIVISION OF
American Machine and Metals, Inc.
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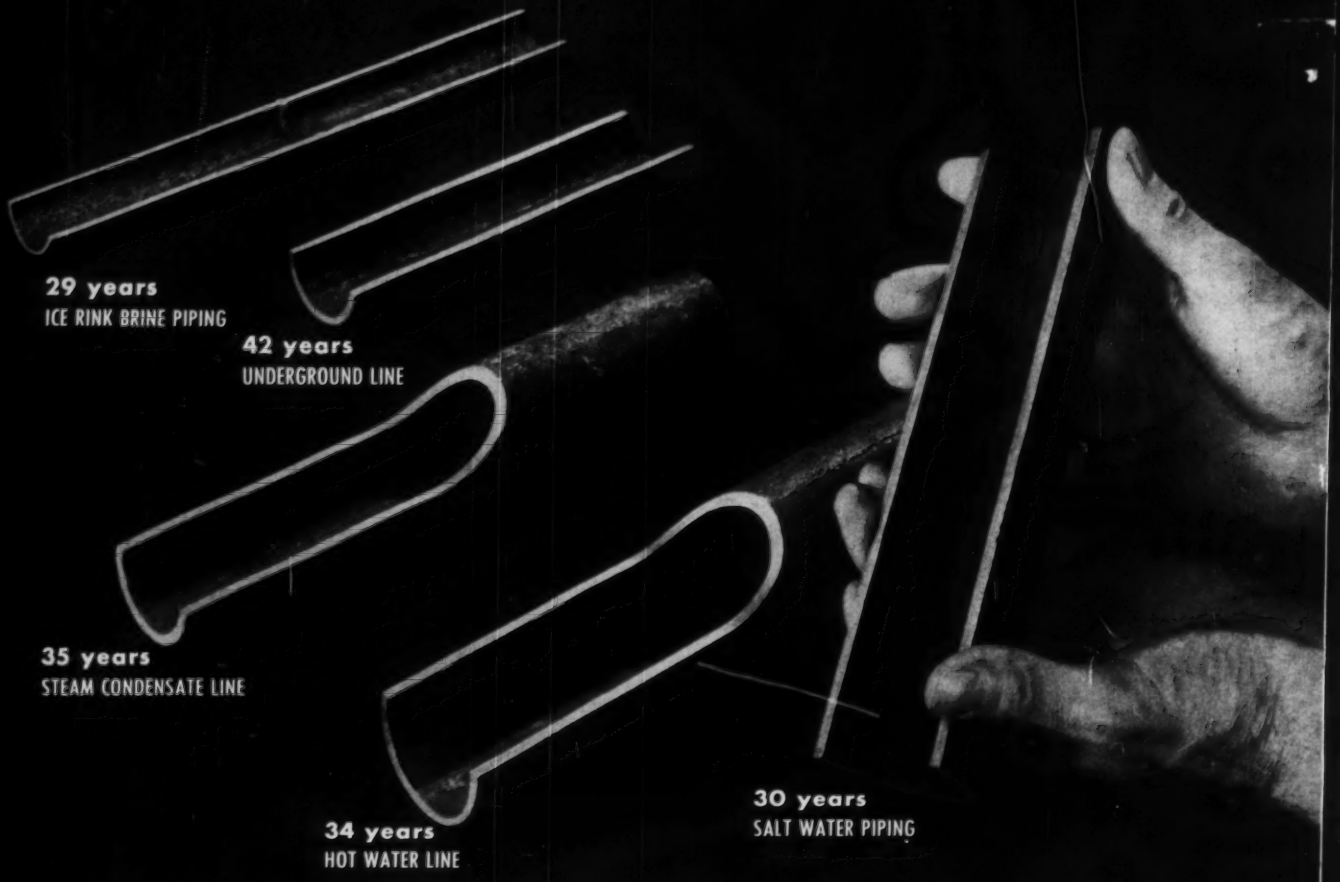
IN CANADA: Represented by DOUGLAS ENGINEERING CO., Ltd., Toronto • Montreal

Here's proof of standard wrought iron's piping longevity . . .



Over 250,000 fibers of glasslike iron silicate guard each cross-sectional square inch of wrought iron pipe against corrosion

Now—4-D Wrought Iron Pipe assures even longer service life

There's a practical, fool-proof way to evaluate a piping material's potential in corrosive service: check its performance under actual field conditions.

The photo above shows how standard wrought iron pipe measures up when this service-life yardstick is applied. Here you see actual samples taken from wrought iron pipe installations in a variety of corrosive services. Some of these sections came from buildings that were being torn down. Some were cut from in-use installations by our laboratory staff. They tell a convincing story of piping longevity.

Now, new 4-D Wrought Iron is available to further augment the qualities of *standard* wrought iron, known for decades as the optimum in corrosion resistance. And increased corrosion resistance, improved mechanical and physcial properties and greater uniformity widen the gap between 4-D Wrought Iron and ferrous substitutes. In-service and comparative laboratory tests support this conclusively.

Ask the Byers representative to relate the advantages of new 4-D Wrought Iron to your corrosive applications. And write us for new 4-D Wrought Iron literature and test data. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

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TUBULAR AND FLAT ROLLED PRODUCTS

ALSO AMBALLOY ELECTRIC FURNACE STEELS AND PVC PIPE AND SHEET

Heating Piping & Air Conditioning

Vol. 30, No. 12

December 1958

(With which is merged the Aerologist)

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How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

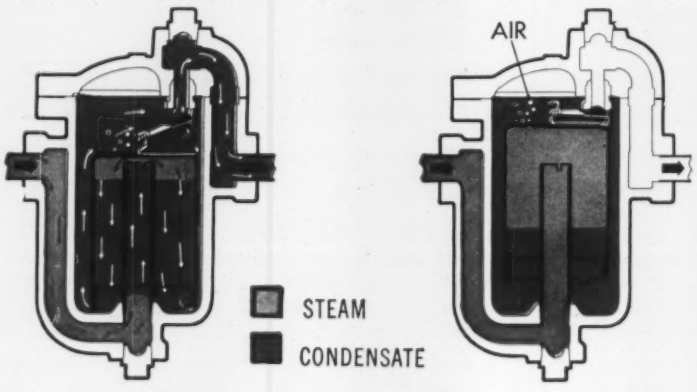
By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

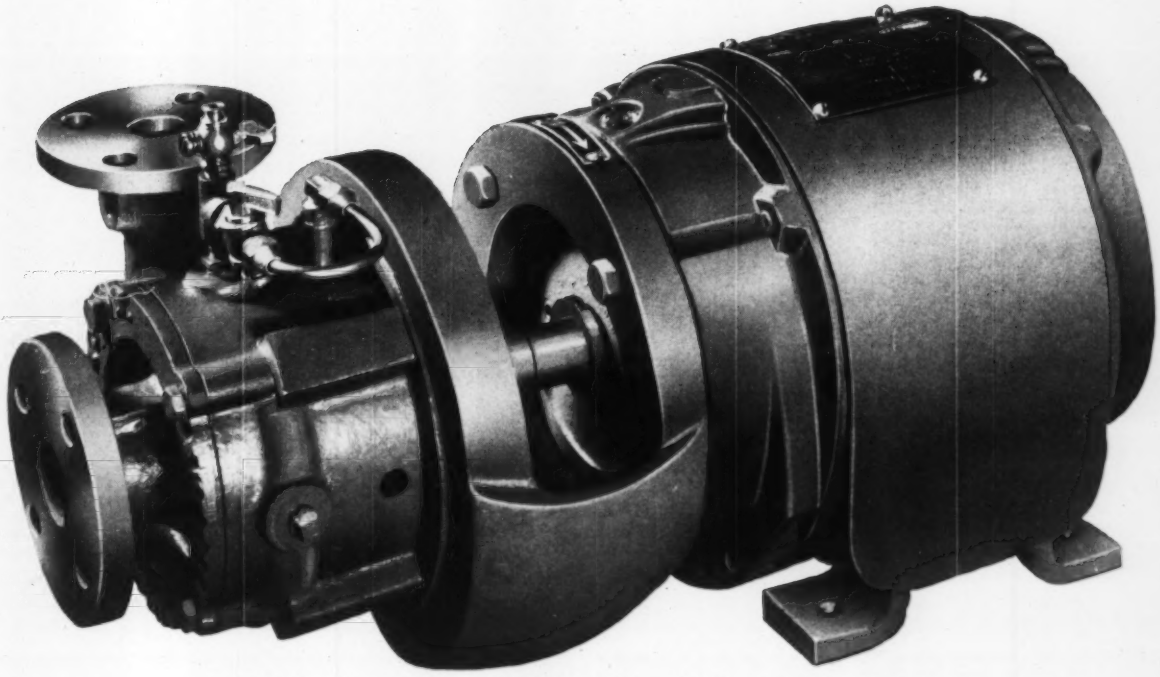
We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

Armstrong Machine Works
8743 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS



"Buffalo" Close-Coupled Pumps are available in six models: 1" to 6" sizes; 5 to 1100 gpm; up to 360 ft. head (290 - 300 gpm).

BIG PUMP PERFORMANCE

IN A SMALL SPACE!

"BUFFALO" CLOSE-COUPLED PUMPS

Compact, rugged "Buffalo" Close-Coupled Single Suction Pumps are designed for clear water services (including chilled water) where space is at a premium. Check these many advantages:

- **Easy To Install** — Permanently aligned shafts and adjustable discharge angle afford maximum flexibility in mounting and piping.
- **Easy and Economical To Service** — Removable side plates give quick access to rotors. Interchangeability of parts means lower inventory costs.
- **Peak Performance and Dependability** — Quality materials and quality manufacturing assure the famous "Buffalo" efficiency and long maintenance-free life. Sturdy construction features include deep stuffing boxes, integrally-cast with the rigid casings — statically and hydraulically balanced impellers to provide smooth operation — extended motor shafts designed for extreme strength.

For maximum pump performance in a minimum of space, your wisest choice is "Buffalo" Close-Coupled Pumps. For full information call your "Buffalo" representative, or write for Bulletin 975-F.

All "Buffalo" Pumps bring you the "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

"Buffalo" PUMPS

BUFFALO PUMPS

Division of Buffalo Forge Company

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Workhorse durability plus precision machine efficiency equals BIG performance. All new G. I. Fans incorporate advanced aerodynamic techniques that combine improved efficiency with all the advantages of the flat radial blade design. G. I. Fans offer endurance through heavy construction with extra-heavy bracing, and provide stable performance in operation. These versatile fans are available for operation from –300° F. to 1000° F.

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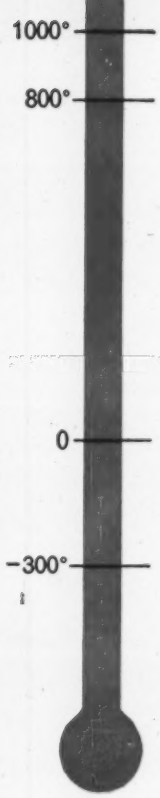

...featuring flat radial blade wheels

THREE WHEEL TYPES FOR RUGGED PERFORMANCE

Because of the varied demands of industry, three wheel types are offered to provide optimum performance for virtually any type application.

LS Type—designed for coarse materials and abrasive particles . . . ideal for sticky, heavy or abrasive dust problems . . . extremely easy to clean . . . also for corrosive or heavy fumes . . . for temperatures to 800° F.

RIM Type—used in similar applications to LS Type, and comparable in performance . . . for higher temperatures, RIM Wheels are available for operation to 1000° F.

LM Type—high efficiency design, ideal for industrial process systems involving smoke, gases, or air containing small quantities of fine dust . . . provides efficient fume removal . . . for operation to 800° F.

A packaged industrial fan is also available, in sizes 141 through 361. Economically designed, it features one-man motor installation and removal.

Write for details in Bulletins 585, 586

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Custom Made

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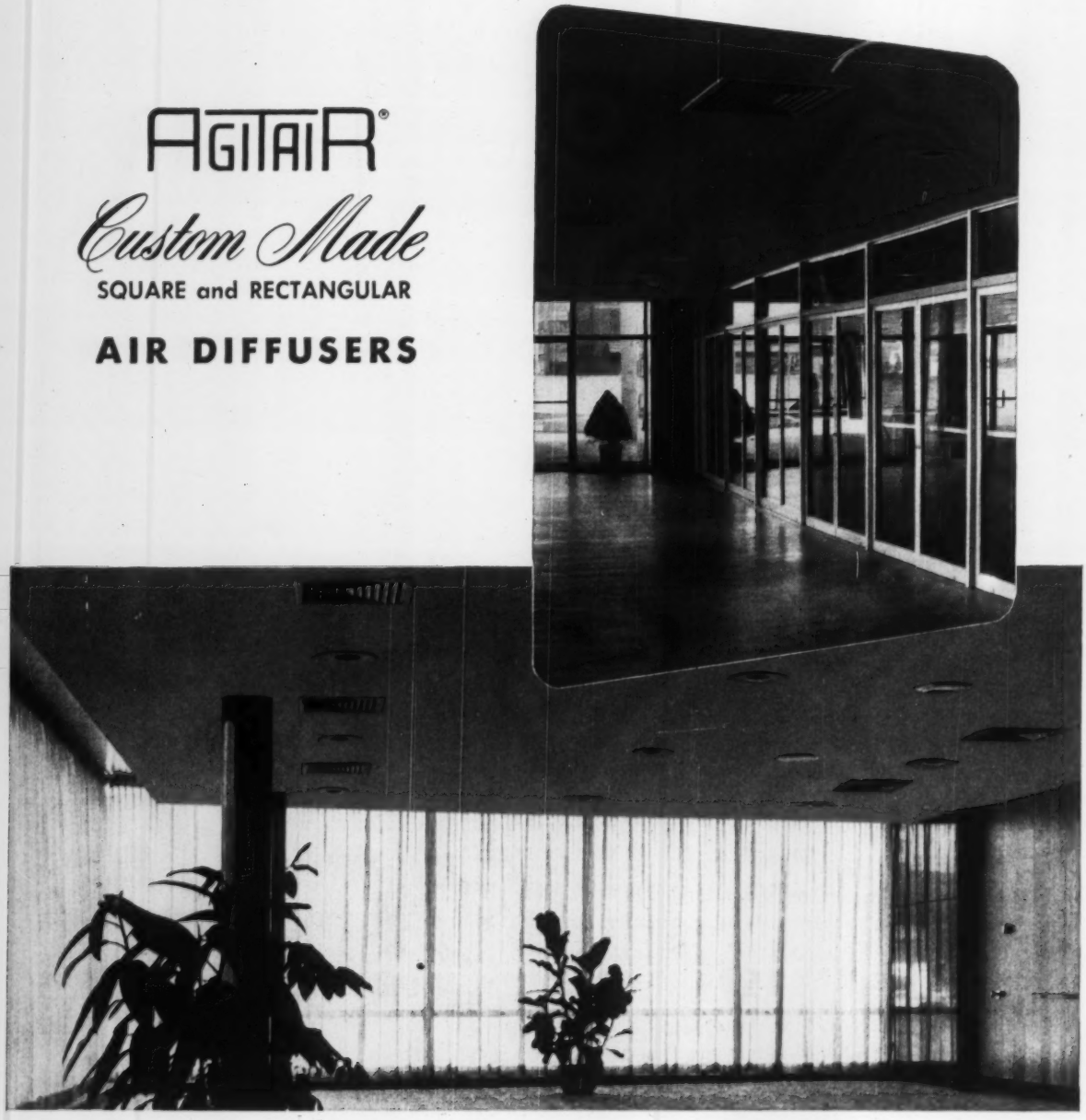
AIR DIFFUSERS



Custom made in unlimited air patterns, AGITAIR square and rectangular air diffusers suit all job conditions . . . blend perfectly with any interior design.

These AGITAIR diffusers need not be centrally located. They assure draftless, noiseless, equalized air distribution from any location in the ceiling or side wall.

Write for Catalog R107 for complete data on these Agitair Diffusers

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high velocity units • punkah louvers
air diffusers • filters • exhausters

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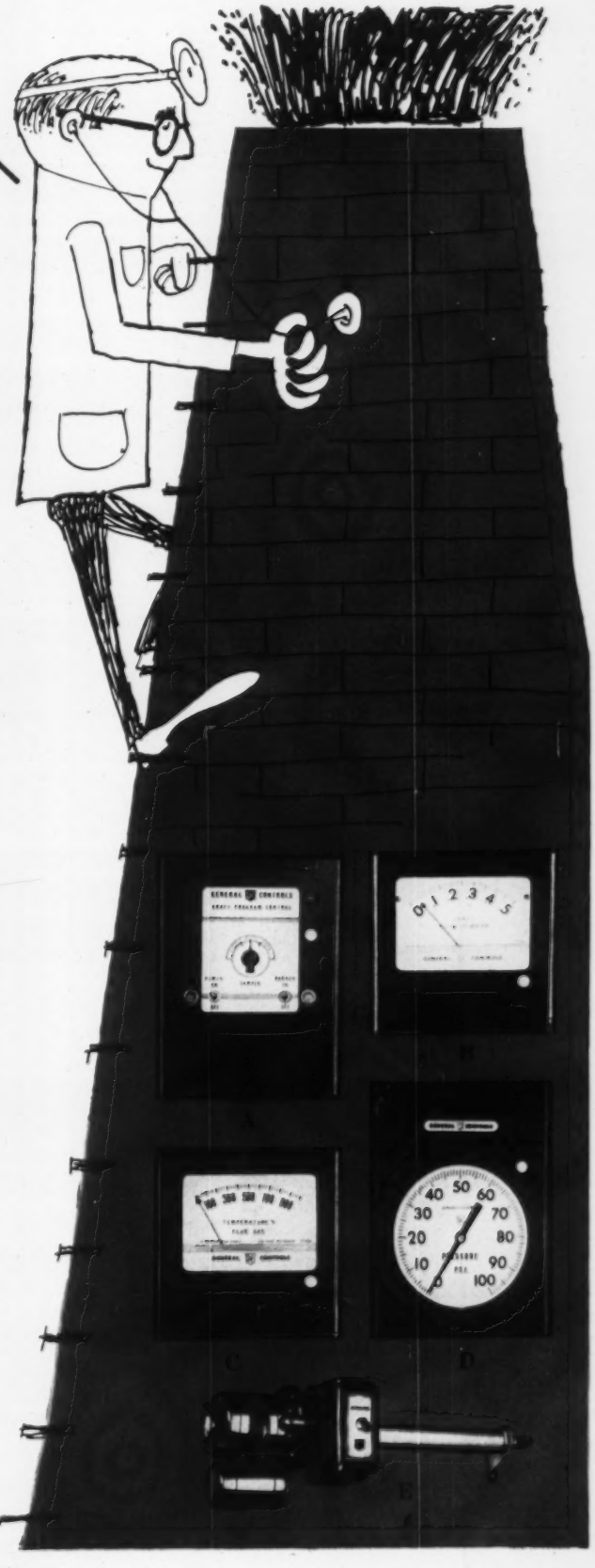
185 MADISON AVENUE, NEW YORK 16, N. Y.

"My advice:
QUIT SMOKING!"



Smoking costs too much. It's a sure sign fuel is being wasted... that burner and boiler are losing efficiency... that profits are going up with the smoke. But you *can* do something about it! **Install a GENERAL CONTROLS DRAFT CONTROL SYSTEM.**

Goes in easily and inexpensively with any type boiler... any type fuel. Pays for itself over and over again through the years by cutting fuel waste... saves as much as 25% on fuel cost as well as saving on manpower. Not least, think of the plant and city-area good will you'll create with effective smoke control.

Call in the GENERAL CONTROLS MAN in your area to check out a draft control system for your plant now. The sooner, the better your long-range profit picture will look.

HOW TO IMPROVE YOUR BOILER EFFICIENCY:

A DRAFT PROGRAM CONTROL: start-up, shut-down, sets damper for any firing rate. Fast, accurate... senses atmospheric changes.

B DRAFT INDICATOR: provides continuous visual readings of draft conditions in combustion chamber and/or stack.

C FLUE GAS TEMPERATURE INDICATOR: shows boiler efficiency by indicating excessive heat loss.

D STEAM PRESSURE INDICATING CONTROLLER: indicates boiler pressure on main instrument panel, and gives accurate on-off, or proportioning control.

E ACTUATOR: operates stack damper to maintain constant combustion chamber draft.

A draft control system like this is worth money in the bank to you. Get the full facts today from

GENERAL CONTROLS

Manufacturers of America's Finest Automatic Controls for Home, Industry and the Military

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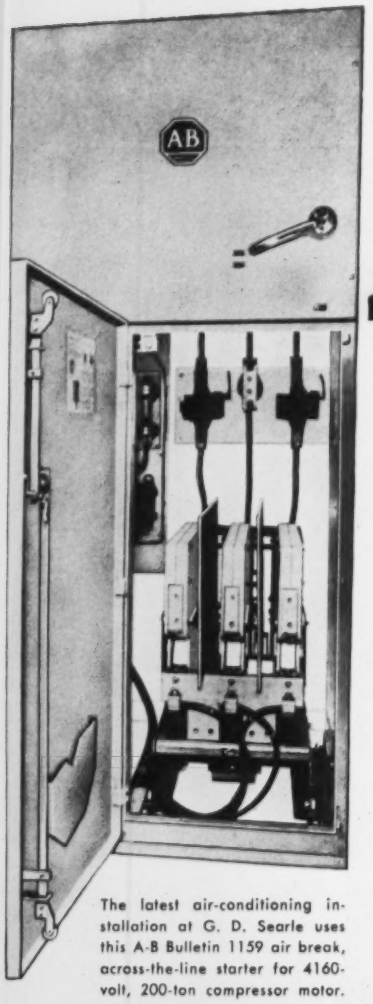
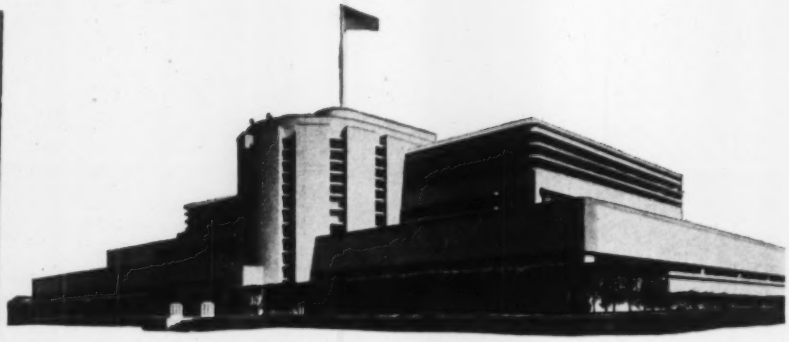
Six Plants—42 factory branch offices serving the United States and Canada



The latest air-conditioning installation at G. D. Searle uses this A-B Bulletin 1159 air break, across-the-line starter for 4160-volt, 200-ton compressor motor.



G. D. Searle & Co. selects

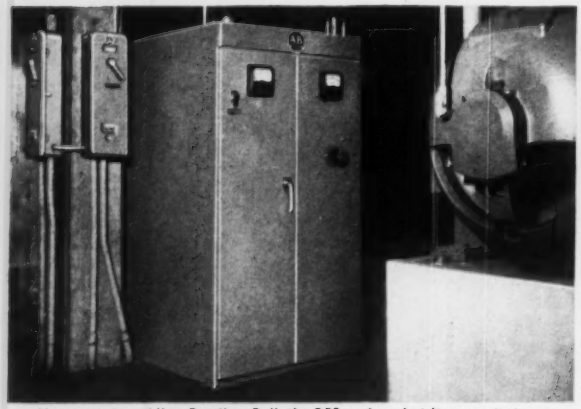
ALLEN-BRADLEY AIR BREAK HIGH VOLTAGE STARTERS

for its air-conditioning system

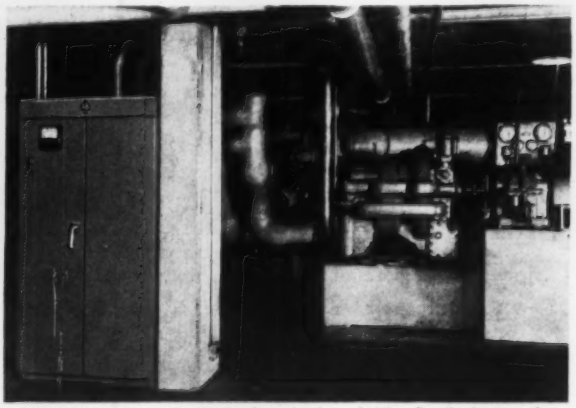
Here's the *most modern*—and *most rugged*—high voltage starter built today! Its simple solenoid, air break contactor—with only ONE moving part—virtually guarantees long life and trouble free operation. This same basic design has been used on all Allen-Bradley low voltage starters . . . and is the outstanding reason for their world-wide success and popularity.

Also, using the double break, silver alloy contacts—a standard feature on *all* A-B motor control—service inspection two or three times a year is all that is necessary. All A-B high voltage starters have permanently accurate thermal overload relays to protect against motor burnouts, and all are equipped with current limiting fuses.

Allen-Bradley high voltage starters are available in a complete line for all types of service—including reversing and plugging—in ratings up to 1500 hp, 2300 v; 2500 hp, 4600 v. For complete information, send for Publication 6080, today.



Here are two Allen-Bradley Bulletin 952 reduced voltage auto-transformer starters operating 4160-volt, 200-ton compressor motors. These starters, using oil-immersed contactors, were put into service many years ago prior to the introduction of Allen-Bradley's new air break contactor. Oil-immersed starters require more attention but provide good service where frequent starting is not required.



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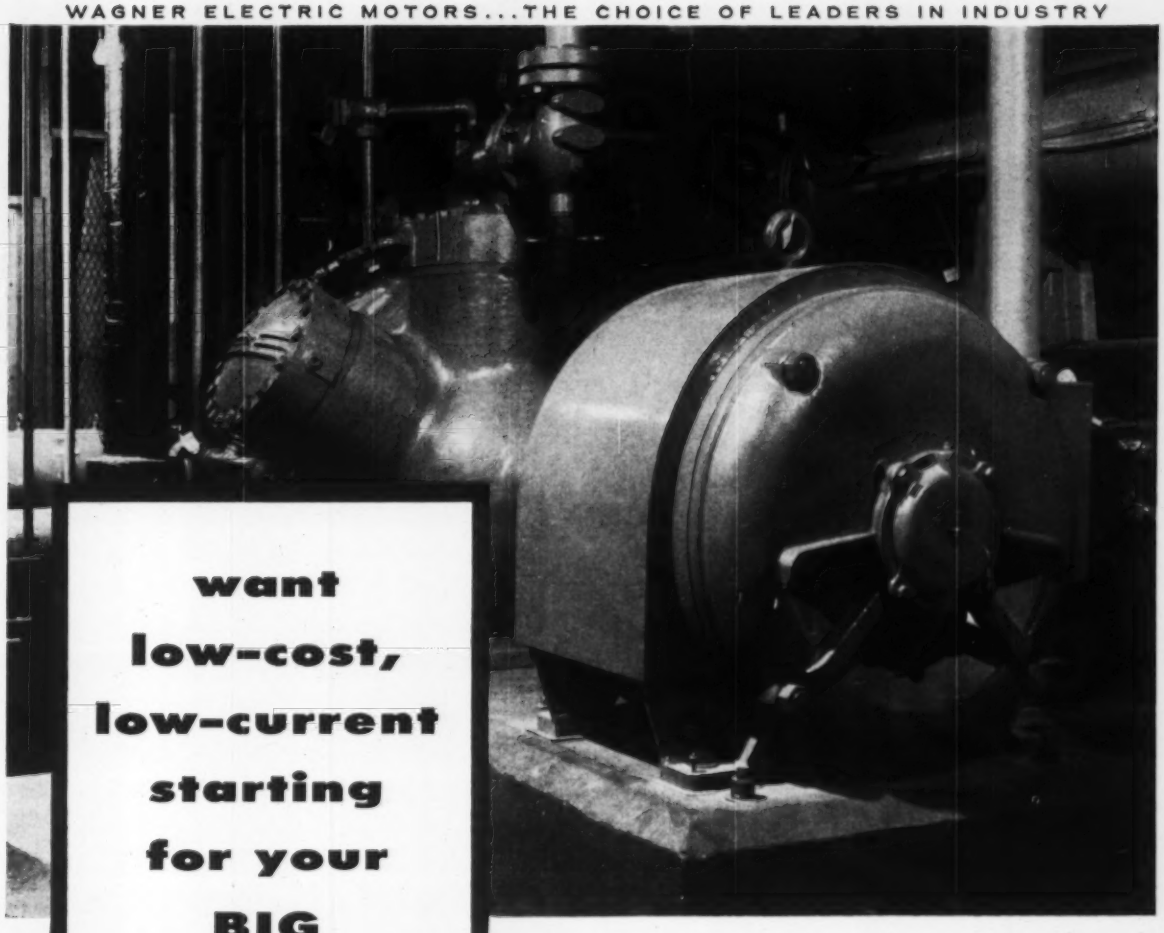
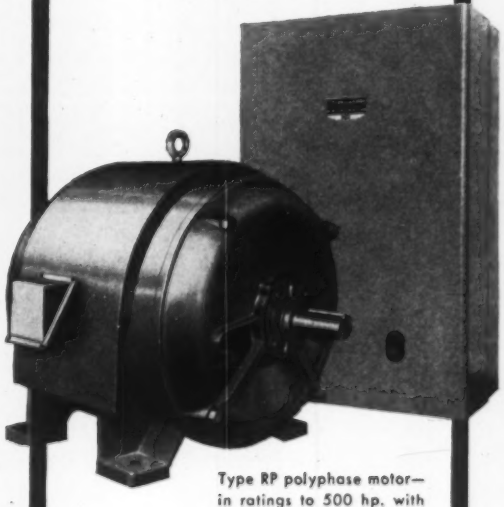


want low-cost, low-current starting for your BIG MOTORS?



Type RP polyphase motor—in ratings to 500 hp, with increment type starter.

Specify Wagner Increment Motor-Starter Combinations

Part-winding starting is the simple, inexpensive way to limit the inrush of starting current in squirrel-cage motors up to 500 horsepower—and only the Wagner Increment Motor-Starter Combination gives you all these advantages:

LOW FIRST COST—Uses a standard Wagner Motor and a part-winding starter—no need for auto-transformers or resistors.

EASE OF INSTALLATION—Starter is compact and relatively light in weight, connections are simple and easy to make.

MINIMUM MAINTENANCE—The Wagner Motor requires only regular inspection, cleaning and lubrication—the starter needs very little attention.

APPROVED BY POWER COMPANIES—Meets all polyphase motor starting requirements of AEIC—EEI—NEMA—reduces voltage fluctuations—does not open the line during the starting period.

PROVED IN SERVICE—Wagner pioneered this Motor-Starter Combination—has been furnishing it for more than 18 years—its steadily increasing popularity is proof of its efficiency and dependability.

Why not take a look at Wagner Increment Motor-Starter Combination in operation? Ask your nearby Wagner Sales Engineer to show you an installation in your area. See how it works—judge for yourself, and let him help you select the combination that meets your requirements. Just call the nearest of our 32 branch offices, or write for Bulletins MU-128 and MU-195.

Wagner Electric Corporation
6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.

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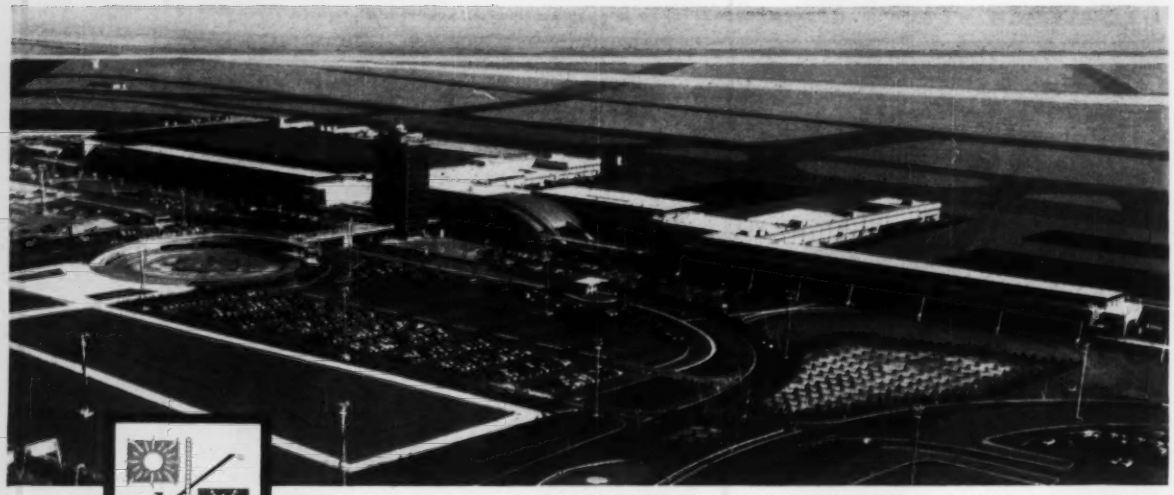
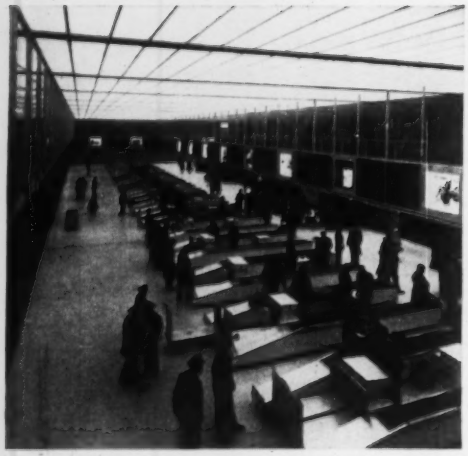


International Arrival and Airline Wing Buildings, New York International Airport. The Port of New York Authority, owner, operator, and engineer. Skidmore, Owings & Merrill, architects; Cauldwell-Wingate Co., general contractor; Eugene J. Brandt & Co., Inc., mechanical contractor, all of New York.

World's Largest Pneumatic Transmission System Keeps Huge Terminal at Its Air Conditioned Best

Dominating the vast $150 million Terminal City being built at New York International Airport is the new International Arrival Building. With its adjoining Airline Wing Buildings, the structure is 11 city blocks long, contains nearly 700,000 sq. ft. of space! By 1965, it is expected to handle over two million overseas passengers per year.

Passenger *comfort* is on a big scale, too. For example, a specially engineered Johnson Pneumatic Temperature Control System directs 70 heating and air conditioning systems supplying over one-half million cubic feet of conditioned air per minute. Forty-four of these serve Port Authority areas. The others supply spaces leased by foreign airlines.



Johnson Thermostats keep all points of the building as comfortable as an executive office. Here, passengers pass through customs with supermarket efficiency.

Nearly 70 *miles* of compressed air piping connect the Johnson pneumatic thermostats, valves and other controls. Utilizing the world's largest pneumatic transmission system, a Johnson Control Center permits Port Authority personnel to supervise their 44 air conditioning systems, check and record room temperatures and make key adjustments—all from a single master panel! Results: an ideal indoor climate for travelers, maximum productivity for building personnel and major savings on heating and cooling costs.

This spacious terminal is one of tens of thousands of fine buildings that are equipped with Johnson Pneumatic Controls. Why not give your clients the same benefits? For immediate help with any temperature control problem, call a nearby Johnson engineer. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

TEMPERATURE CONTROL SYSTEMS FOR SCHOOLS, OFFICES, FACTORIES, STORES, HOSPITALS, HOTELS, PUBLIC BUILDINGS

something great

has happened to steam lines..

..the improved

GUN-PAKT EXPANSION JOINT

Part of an installation of 37 new Yarway Gun-Pakt Expansion Joints at a Mid-West state institution

Details of new packing gun arrangement on Gun-Pakt Joints

With the many types of expansion joints available today for steam lines, it's important for engineers to "know their joints" when making a choice. Engineers know that Gun-Pakt maintenance costs have *always* been exceptionally low.

NOW . . . with the new Yarway Type W Gun-Pakt expansion joint you have these important *added* advantages—

CONVENIENCE—improved angle of packing guns makes them more accessible, thus reducing maintenance costs.

INCREASED STRENGTH—thanks to new one-piece integral body and gland.

LOWER MAINTENANCE—new packing gun design permits injection of special plastic packing *directly into packing space under full steam pressure. No need for costly shut-downs for repacking.*

Now is the time to find out more about Gun-Pakt joints. Write for Yarway Bulletin EJ-1916.

YARNALL-WARING COMPANY
107 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

GO YARWAY WITH CONFIDENCE

MULTI-VENT®

low velocity air diffusers specified for the West's largest office building

Multi-Vent will handle the air distribution in over 70% of Kaiser Center's office building, the largest west of the Mississippi, scheduled for completion late in 1959.

Multi-Vent is the ideal air diffuser for office space because it need never be moved, or even adjusted when partitions are relocated. Distributing air at low velocities by gentle pressure displacement, Multi-Vent provides truly sightless, soundless, imperceptible air conditioning comfort, unmatched by any other diffuser.

Multi-Vent panels, adjustable valves and flexible duct connections are concealed in metal pan ceilings because standard perforated pans (with acoustic pads removed) serve as diffuser plates. Panels (with diffuser plate) install flush in plaster and fiber ceilings.

KAISER CENTER, Oakland, California

Architect: Welton-Becket & Associates, San Francisco
Mechanical Engineer: Dudley, Deane & Associates, San Francisco
Mechanical Contractor: Scott Company, Oakland

Recent Multi-Vent Installations Coast to Coast

Banker's Trust, New York City
Baptist Tabernacle, Atlanta
Boeing Airplane Co., Seattle
Ford Motor Co., 21 Buildings
Graybar Electric, Illinois
Inland Steel Building, Chicago
National Bank of Detroit, Detroit
Parke Davis Bldg. 64, Detroit
Procter & Gamble Tech. Center, Cincinnati
Prudential Insurance Co., Newark
Travelers Insurance Co., Hartford

Write for detailed literature.

THE PYLE-NATIONAL COMPANY

MULTI-VENT DIVISION

WHERE QUALITY IS TRADITIONAL

1373 N. Kostner Avenue, Chicago 51, Illinois

SALES AGENTS IN PRINCIPAL CITIES OF THE UNITED STATES AND CANADA

Just completed . . . a spanking-new plant at Institute, West Virginia, built by Union Carbide Chemicals Company to supply 50 million pounds of fluorocarbons a year! That means new UCON Refrigerants are available now . . . bringing you *all* the advantages of the nation's newest refrigerants. You'll get . . .

UNSURPASSED QUALITY, meeting the strictest refrigeration and air conditioning industry standards for dryness and purity.

NEW PERSONALIZED SERVICE from technically-trained representatives—the UCON Refrigerants service force is the largest in the country.

ON-TIME DELIVERY from the largest network of distribution points serving the refrigeration and air conditioning industries.

FULL CHOICE OF UNIT SIZES. Meet *your* quantity needs with UCON Refrigerants supplied in standard-sized units.

TO GET FULL DATA ON UCON Refrigerants now, see your wholesaler, or write: UCON Refrigerants, Union Carbide Chemicals Company, 30 East 42nd Street, New York 17, N. Y. Call, write or wire us, any time! Attention, Dept. F-12.

"Ucon" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

Ucon
BRAND
refrigerants

These 5 UCON Brand Refrigerants will meet your refrigeration and air conditioning needs

UCON Refrigerant 11 Trichloromonofluoromethane
UCON Refrigerant 12 Dichlorodifluoromethane
UCON Refrigerant 22 Monochlorodifluoromethane
UCON Refrigerant 113 Trichlorotrifluoroethane
UCON Refrigerant 114 Dichlorotetrafluoroethane

UNION CARBIDE CHEMICALS COMPANY *Division of Union Carbide Corporation*

Cut, form, hammer USS Galvanized Steel Sheets

—the zinc stays on

These are the galvanized steel sheets that take the sharp bends you see in the best-made ductwork. They're USS Galvanized Steel Sheets—strong, yet easy to form. USS Galvanized Steel Sheets *stay protected* because the zinc stays on. Cut, form, roll, hammer, lock-seam these sheets—no zinc flakes off the steel. Pride in your workmanship should be backed by the best of materials.

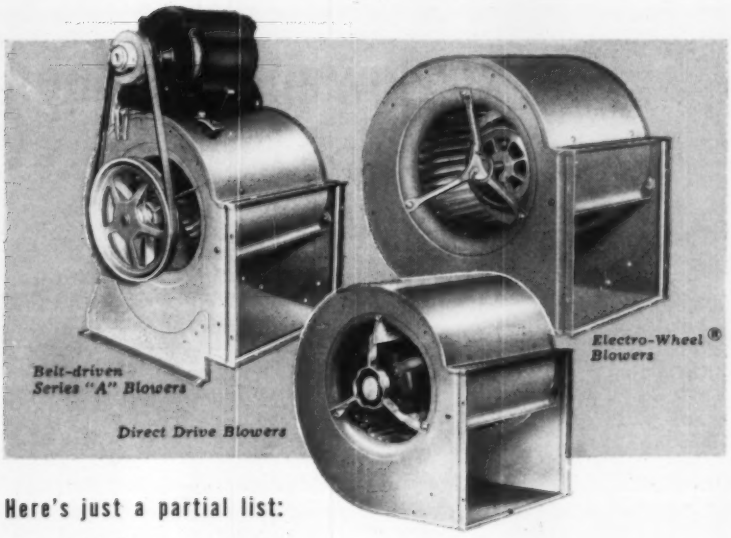
Why not make *your* ductwork with top-quality steel—use USS Galvanized Steel Sheets.

USS is a registered trademark

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
American Steel & Wire—Cleveland
United States Steel Supply—Steel Service Centers
United States Steel Export Company

USS United States Steel

There are good reasons why these leaders look to LAU —



Here's just a partial list:

Metromatic Mfg. Co., Inc.
Montag Stove & Furnace Works
Morrison Steel Products, Inc.
Mortemp Division
The Norwalk Airconditioning Corp.
Reznor Manufacturing Company
Roberts-Gordon Appliance Corp.
Tuck-Aire Furnace Company
Williams Furnace Co.
The XXTH Century Heating & Ventilating Co.
American Furnace Company
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General Automatic Products Corporation
E. D. Goodfellow Co., Inc.
Gordon Enterprises
Larkin Coils, Inc.

THE BIG WHEEL in air moving

Engineering advances such as Preslok® construction and Electro-Wheel Blowers. Delivery—quick and sure. Competitive prices. Talk to any of our customers and you'll find they have good reasons for calling LAU to help them move air. Maybe that's why we've grown each year until we sell more blowers and components than any other manufacturer. And isn't that a pretty good reason for seeing LAU about your air moving problems? **LAU Blower Company,** 2027 Home Ave., Dayton 17, Ohio. OTHER PLANTS at Irwindale, Calif., and Kitchener, Ont.

Leaders look to these LAU Sales-Engineers for on-the-spot help . . .

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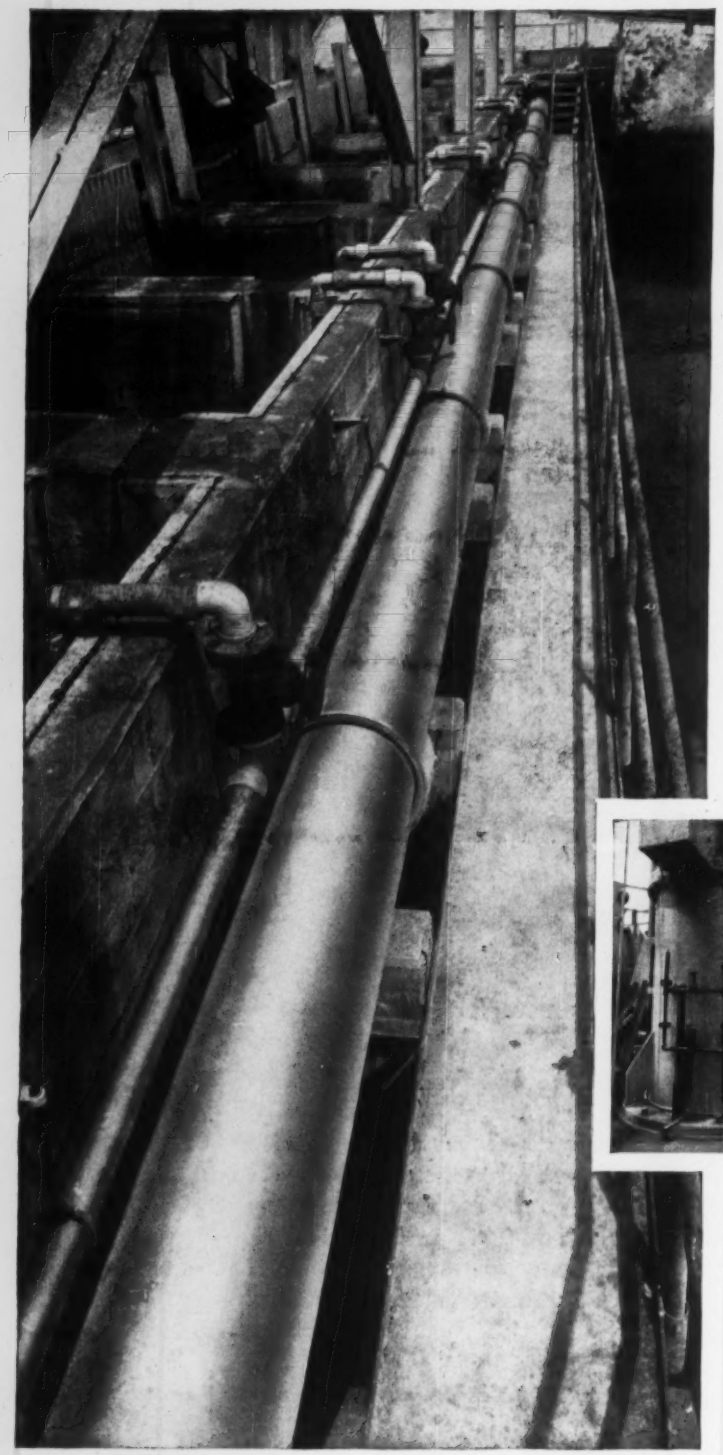
News about

B.F.Goodrich Chemical *raw materials*



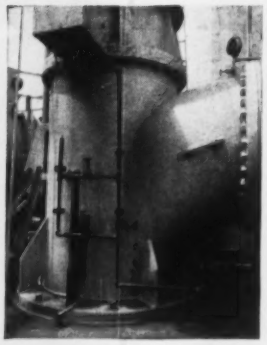
AT FLORIDA POWER & LIGHT'S CUTLER GENERATING STATION

How pipe of Geon helps cut maintenance

The large photo shows 3½" pipe made from Geon rigid vinyl material that is used to feed an aqueous solution of chlorine into sea water just ahead of bar screens at the intake structure. The chlorine prevents buildup of algae in condenser tubes and in the circulating water system.

The smaller photo shows more pipe of Geon circulating salt water to cool the bearings of circulating water pumps. Geon is not affected either by salt water or most chemicals—which proves its value in still another part of this large generating station.

Geon is used to pipe the acid bearing (H_2SO_4) wash-down water from the boiler waste hopper to the discharge canal. Geon piping is used also for pumping salt water to the soot disposal collectors.



Geon pipe and conduit also provide high impact and tensile strength. Both are lightweight, easy to install. They are examples of the way that versatile Geon provides the key to new and improved products or applications. For information, write Dept. LW-6 B.F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON polyvinyl materials • HYCAR American rubber and latex
GOOD-RITE chemicals and plasticizers • HARMON colors

1st National Bank Building, Tulsa, Okla., is equipped with B&G Monoflo Fittings. Carson and Lundin, Architects.

NEVER HAS A PROPERLY DESIGNED B&G *MONOFLO*® SYSTEM FAILED!

From small residence to the largest conceivable installation, B&G Monoflo Fittings assure a correctly balanced one-pipe forced hot water system.

B&G Monoflo Fittings enable you to design a one-pipe forced hot water heating system of any size with assurance that it will be correctly and efficiently circulated. That's because the Monoflo Fitting is an *engineered* device—not just a "scoop" or "choke."

These Fittings are designed to handle definite radiator sizes, maintain proper temperature drops and permit the use of economical riser sizes. They provide adequate diversion under average conditions *without introducing excessive resistance.*

An exclusive feature of B&G Monoflo Fittings is that there is virtually no limit to the number which can be installed in any circuit of a one-pipe forced hot water system. Design problems which otherwise occur are eliminated.

Complete design procedure for B&G Monoflo heating systems is found in the B&G Handbook.

Heat in this residence is properly distributed by B&G Monoflo Fittings

NEW "RED-RING" COPPER MONOFLO®

Made in 1" and 1¼" sizes, the "Red-Ring" can be used for up-feed, down-feed, supply, return, one or two-fitting installations. Just keep the "red-ring" *between* the risers.

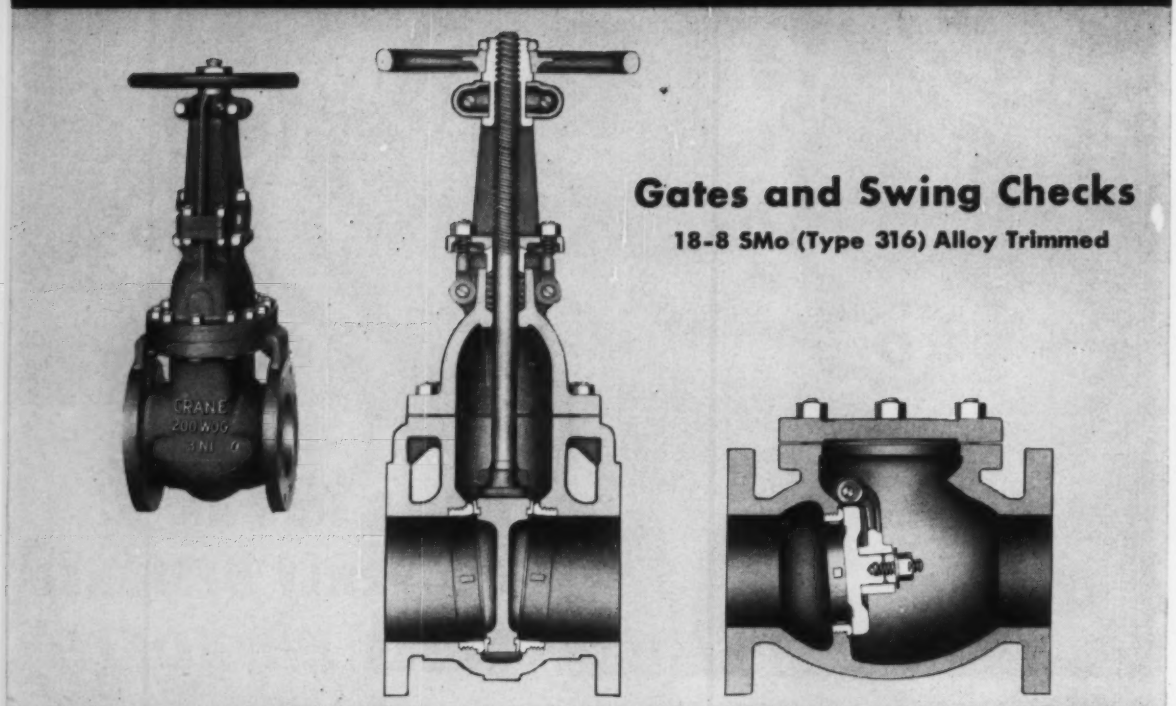
Reg. U.S. Pat. Off.

BELL & GOSSETT
COMPANY
Dept. FN-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

NEW CRANE VALVES FOR PROCESS INDUSTRIES

3% NICKEL ALLOY CAST IRON



Gates and Swing Checks

18-8 SMo (Type 316) Alloy Trimmed

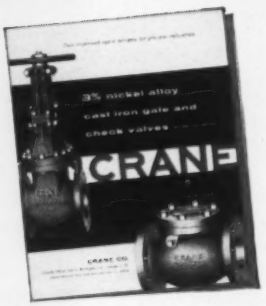
11 SIZES — 2 TO 18 INCHES

Better Corrosion Resistance . . . Longer Life . . . on More Fluids

This metal—Crane 3% nickel alloy iron—was developed especially to extend the usefulness and economy of cast iron valves in the process industries.

At but slightly higher cost, Crane 3% nickel iron valves provide substantially better resistance to corrosion than ordinary cast iron, and they have notably higher physical properties. Efficiency is stepped up further with Crane 18-8 SMo (Type 316) stainless steel trim.

Typical Recommended Applications: You will save with these valves —in the petroleum industry, for example—on oils containing traces of mineral acids; in wood-treating processes—on creosote vapors and oils; in pulp and paper mills—on alkaline liquors of various kinds. In general, they should be considered where all-iron or brass-trimmed iron valves are subject to seat corrosion.



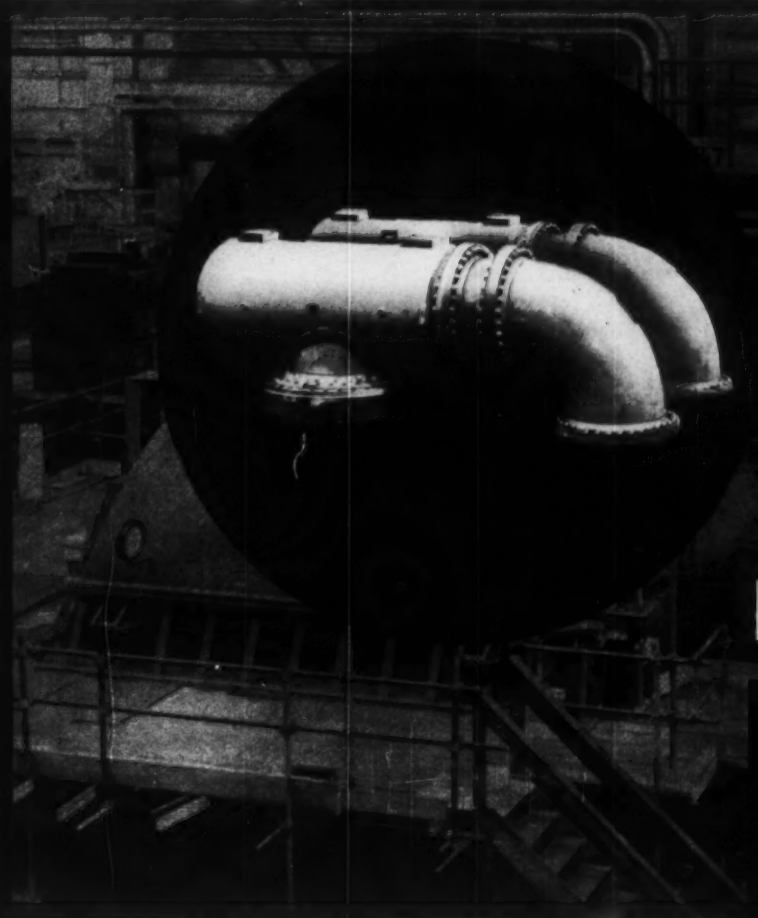
ASK FOR THIS CIRCULAR

Complete technical and specification data on these valves are given in Circular AD-2313. Ask your Crane Representative for a copy, or write to address below.

CRANE VALVES & FITTINGS

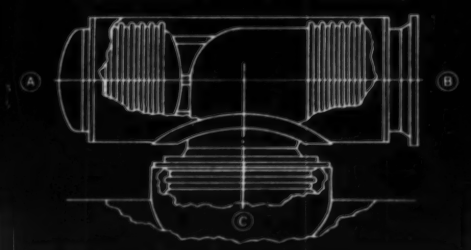
PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches and Wholesalers Serving All Areas



GIANT Turbine Expansion Joints Built by BADGER

Badger balanced elbow expansion assembly.



Joint A balances thrust due to internal pressure of 65-150 psi; joint B absorbs axial movement; joint C absorbs the differential expansion between the inner and outer casings of the turbine. Assemblies range in size from 36 to 42 inches in diameter.

Photo shows 150,000 kw steam turbine-generator unit undergoing tests prior to shipment at General Electric's Turbine-Generator Plant in Schenectady, N. Y. Badger Expansion Assembly is clearly visible atop turbine.

Custom engineered assemblies include many features of Badger S-R Design

750°F steam is flashed through these turbine crossovers at speeds up to 150 ft/sec and pressures up to 150 psi.

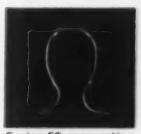
How do you protect piping and turbine casings from the stresses of extreme internal pressure and the expansion such temperature is bound to produce?

Working together, Badger and engineers at General Electric's Large Steam Turbine-Generator Department solved the problem with a new type pressure balanced elbow expansion assembly. Using two separate joints mounted in a T-shape casing (see diagram) the assembly effectively absorbs and controls axial movement. Although the device was custom engineered to General Electric's requirements, the bellows elements are constructed to the Curvilinear Corrugation design recently announced by Badger and now used in all S-R Expansion Joints.

Whether you need standard S-R Expansion Joints or custom equipment, Badger can serve your needs. Get more information — write for illustrated brochure today.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced... life increased.



Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer life.

Series 150 corrugation and ring cross-section

BADGER

S R

SERVICE RATED

EXPANSION JOINTS

© 1958 BMC

BADGER MANUFACTURING COMPANY

230 Bent St., Cambridge 41, Mass. • 60 East 42nd St., New York, New York

Representatives in Principal Cities

MORE *Models*
MORE *Capacity*
MORE *Performance*

AIRCON
Air Cooled Condenser

McQuay AIR COOLED CONDENSERS

UP TO 50 TONS IN A SINGLE UNIT—UNLIMITED CAPACITY IN MULTIPLE INSTALLATION

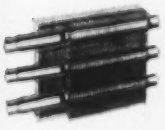
McQuay Aircon remote waterless condenser. Ten models, 3 to 50 ton capacity. Belt or direct drive models. Lifetime ball bearing and slow speed propeller type fans. McQuay Seasontrol modulates condenser capacity in accordance with weather for peak performance all year 'round.

WHEN you use McQuay Aircon air cooled condensers you have 10 models to choose from and you get from 3 ton to 50 ton capacity in a single unit! With multiple installations, capacities are unlimited.

You not only get more models and more capacity but you get more performance, because McQuay Aircons have the exclusive McQuay Ripple Fin coils—the finest and the standard of the industry.

With the present emphasis on remote waterless condensers, look to McQuay. Compare construction, compare features, compare the all around quality. Belt or direct drive models are offered. See your McQuay representative or write McQuay, Inc., 1601 Broadway Street N.E., Minneapolis 13, Minnesota.

McQuay Means Quality



McQuay units feature the exclusive Ripple Fin Coils which create maximum air turbulence and have wide, full fin collars that act as automatic spacers to form a tube around the coil tube for greatest heat transfer and protection.

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

Individually, or in combination,

these factors purchase-control every job in heating, piping and air conditioning

You have to reach *all* of these specifying and buying factors—*no one alone* covers the market for you.

Besides their unquestioned control of purchasing, in the industrial-large building field, how else do these KEY factors "fit together"? In this way: As a group, they form the *reader*-audience of HEATING, PIPING & AIR CONDITIONING.

How do these engineers and contractors regard HP&AC? The provable answer is—HP&AC has the largest and only fully paid circulation in its field.

How do manufacturers and their agencies rate HP&AC? Again, the answer is provable—HP&AC leads by over 2 to 1 in advertising volume, has more advertisers, and is used on an exclusive basis by more advertisers.

Where do your products fit into the puzzle? Complete information by return mail.

SYMBOLS OF WANTEDNESS

Heating, Piping & Air Conditioning

Air Conditioning Headquarters

KEENEY PUBLISHING CO., 6 N. MICHIGAN AVE., CHICAGO 2

No Matter what the Size... Sporlan gives ANY Air Conditioning Installation PEAK PERFORMANCE Right Down the Line!

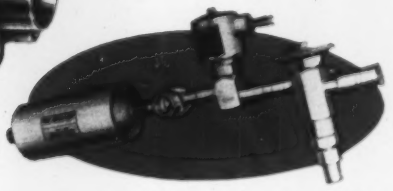
Systems from ¾ to 100 tons are kept perfectly dry with the famous **Sporlan Catch-All** filter-driers.

THE See-All

The amazing new **Sporlan See-All** shows you at a glance the degree of dryness and the amount of refrigerant the system is carrying.

Sporlan Solenoid Valves with the Power Packed Blue Seal Coil defy burn-outs.

Only Sporlan Thermostatic Expansion Valves for air conditioning offer the Flow Master element, which minimizes valve hunting... smooths out evaporator performance regardless of size.



Sporlan Refrigerant Distributors give uniform distribution for any number of circuits regardless of load or evaporator temperatures. They permit a wide range of coil applications... thanks to the Sporlan interchangeable nozzle!

Buy Sporlan Right Down the Line from your wholesaler for your next air conditioning installation, and no matter what the size of the job, Peak Performance Right Down the Line will be yours!

SPORLAN VALVE COMPANY

7525 SUSSEX AVENUE ST. LOUIS 17, MISSOURI

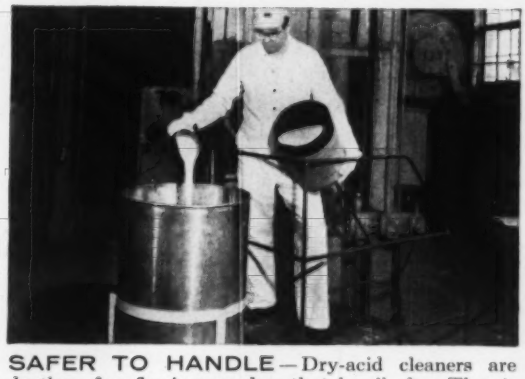
We are expecting you at **Booth 52**

14TH INTERNATIONAL HEATING and AIR CONDITIONING EXPOSITION · JANUARY 26-29, 1959

CONVENTION HALL · · · PHILADELPHIA, PA.

Here are the reasons why—

DRY-ACID CLEANERS based on Du Pont Sulfamic Acid are gaining favor in industrial equipment cleaning

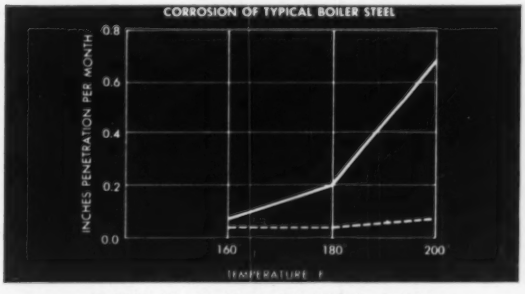


SAFER TO HANDLE—Dry-acid cleaners are dustless, free-flowing powders that *handle* dry. There's no danger of spillage, spatter of liquids or broken bottles.

EASIER TO USE—No siphoning or cumbersome pouring of liquid acid—just scoop or shovel dry acid into make-up tank.

LOWER HANDLING COSTS—Packaged in convenient, easily handled and stored, disposable drums in a variety of sizes. *100-lb.* drum is more than equal to one carboy of 18° hydrochloric acid (gross weight 192 lbs.).

NO HAZARDOUS FUMES—Dry-acid compounds are non-fuming, produce no corrosive gases . . . dry *or* in solution. Special precautions necessary in handling ordinary acids are eliminated.



_____ *Inhibited hydrochloric (5% HCl, by weight)*
- - - - - - - *Inhibited Sulfamic Acid (7% by weight)*

LESS CORROSIVE—Cleaners based on Du Pont Sulfamic Acid form solutions equal to hydrochloric acid in penetrating power, yet are far less corrosive (as shown by graph above).

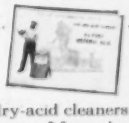
Cleaners based on Du Pont Sulfamic Acid are ideal for removing hard-water scale and other mineral deposits from industrial equipment such as air conditioning and ice-making units, food-processing vessels, steam boilers, milk evaporators and pasteurizers, marine evaporators and heat exchangers.

We'll gladly send you additional information on sulfamic-acid-based cleaners and the names of formulators who offer these cleaning compounds. E. I. du Pont de Nemours & Co. (Inc.), Grasselli Chemicals Dept., Room N-2533, Wilmington 98, Del.

DU PONT SULFAMIC ACID

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*



E. I. du Pont de Nemours & Co. (Inc.)
Grasselli Chemicals Dept., Rm. N-2533
Wilmington 98, Delaware

Please send me ( ) free booklet about dry-acid cleaners based on Du Pont Sulfamic Acid. ( ) Names of formulators who offer these cleaning compounds.

*Name*_____

*Firm*_____ *Title*_____

*Address*_____

*City*_____ *State*_____

NEW IMPROVED

Airtherm

PROPELLER FAN

UNIT HEATERS

FOR STEAM OR HOT WATER

A SIZE FOR EVERY REQUIREMENT

The new Airtherm line incorporates 22 completely redesigned vertical units and 24 improved horizontal units, ranging from 18,000 to 555,000 BTU per hour, with a choice of outlet diffusers to cover practically every air distribution pattern and mounting height. Silent operation is assured by resiliently mounted motors, properly designed fans and casings, and attention to face and outlet velocities. All fans are expertly positioned, balanced and tested. Each unit is tested and rated for performance in strict accordance with the Standard Test Code of the industry. Only brand name, continuous duty motors, especially made for the purpose, are used and mountings are designed for efficient cooling and easy servicing. Rugged coils are formed by hydraulically expanding copper tubing into plate type aluminum fins, each with its own collar, providing increased heat transfer and wide, even spacing to reduce clogging. All coils are tested and tagged for 500 p.s.i. hydrostatic pressure. Casings are phosphatized to insure a long, rust-free life for the attractive baked enamel hammer tone finish.

For Complete Specifications Including a Guide for Selection and Application, Write:

AIRTHERM MANUFACTURING CO.

702 S. SPRING AVE. • ST. LOUIS 10, MO.

Skidmore Pumps

Here are the answers to— your Heating Pump Problems

NEW!

CLOSE-COUPLED

CCVS

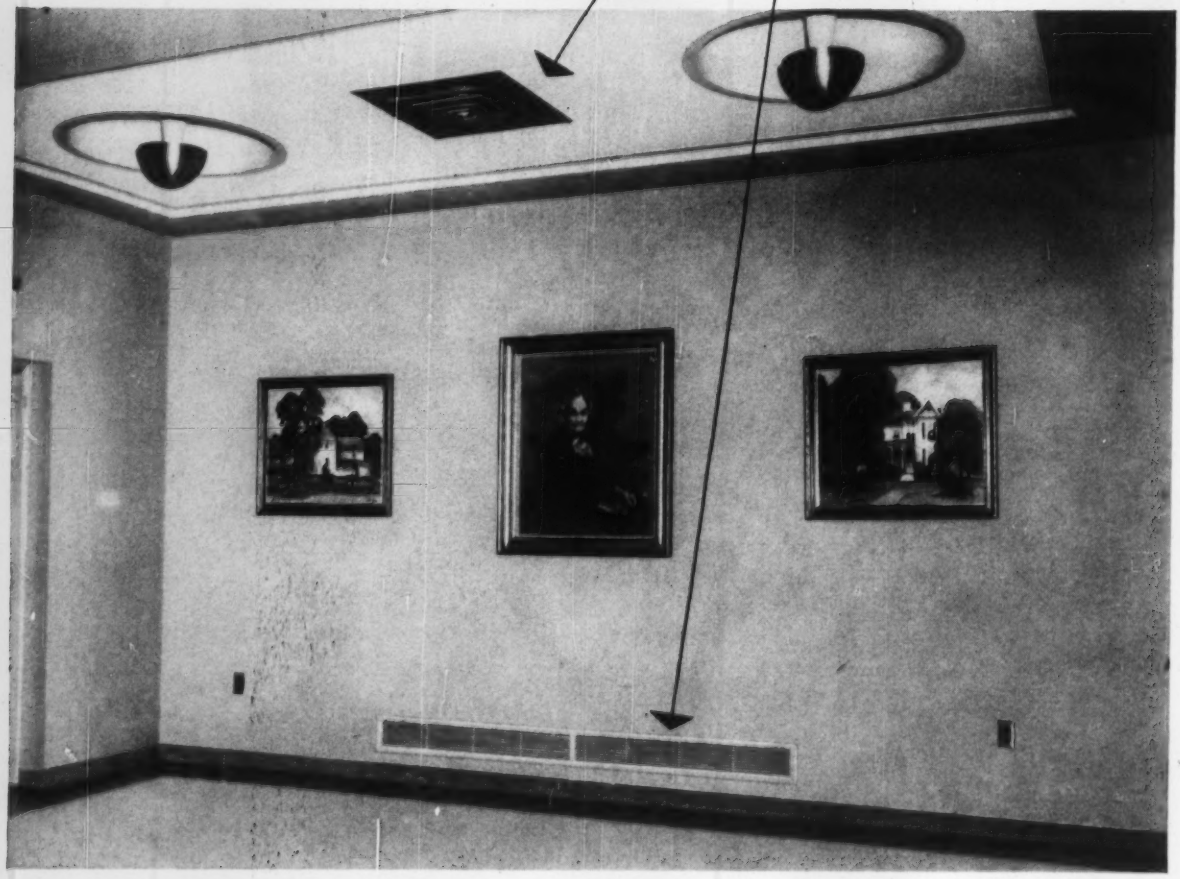
This NEW single unit above has a 6000 sq. ft. EDR with 10 gallon receiver

Here's the NEW Skidmore CCVS Vertical Pump — offering a new high pump efficiency — yet with a minimum motor size. Featuring new Close-coupled design and mechanical shaft seal . . . complete pump and motor unit is bolted to receiver . . . in sizes for all installations: Three new single units and two duplex units . . . can be installed on floor level or in pit. Write for your copy of new bulletin No. 21-C which fully describes these new, rugged, compact CCVS Skidmore Pumps.

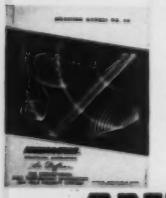
CHOOSE WITH CONFIDENCE

SKIDMORE CORPORATION • ST. JOSEPH, MICHIGAN

Perfect Air Diffusion in the Truman Library with ANEMOSTAT AIR DIFFUSERS *and* WATERLOO GRILLES



Here is a combination—Anemostat Air Diffusers and Waterloo Return Air Grilles—which insures perfect air diffusion in the new Harry S. Truman Library in Independence, Missouri. • Anemostat Type E-1 *Aspirating* Air Diffusers provide true draftless comfort and uniform air distribution in each room of this modern building. Quality-designed Waterloo Grilles act as efficient returns in this system. • Put this performance-proved "team" of Anemostat Air Diffusers and Waterloo Grilles to work in your next heating, ventilating or air conditioning application. They are your assurance of top air diffusion performance.



For complete data on Anemostat Air Diffusers, write for Anemostat Selection Manual No. 60.

For helpful information on Waterloo Registers and Grilles, write for Catalog showing Waterloo's wide range line.

ANEMOSTAT®
DRAFTLESS *Aspirating* AIR DIFFUSERS
ANEMOSTAT CORPORATION OF AMERICA
10 EAST 39TH STREET, NEW YORK 16, N. Y.
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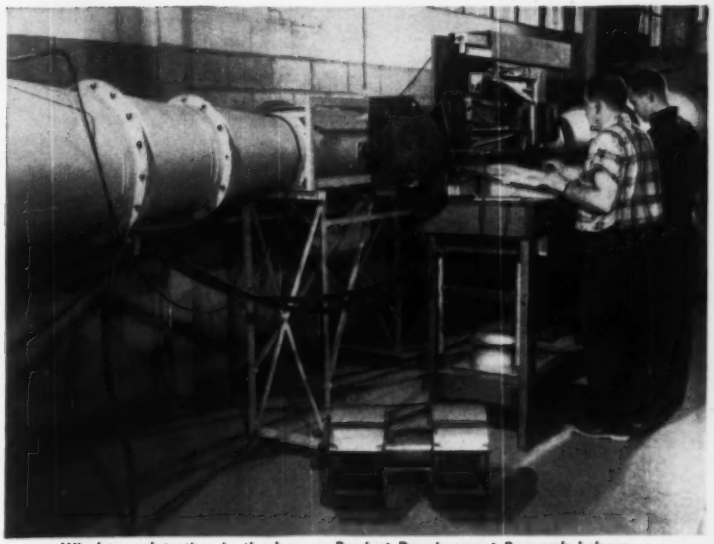
LENNOX INDUSTRIAL HEATERS

...DEVELOPED ...TESTED

in the finest Lennox tradition of superior engineering

From the Lennox Product Development Laboratories come the most thoroughly tested industrial heaters on the market. Modern methods of heat transfer and combustion testing develop heaters adaptable to any application—for heating alone, heating-cooling, ventilating or make-up air requirements. All of this is a part of the continuing Lennox program of technical research.

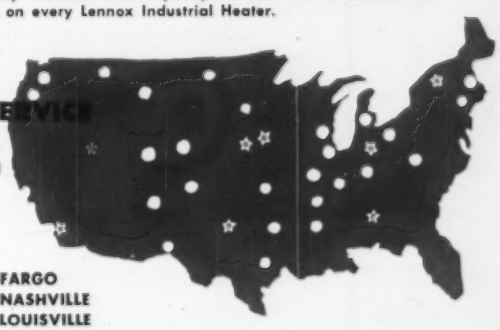
Specify "Lennox or approved equal" and you'll be sure of the best engineered, highest quality equipment in the heating and ventilating field. Send today, for your complete file of Lennox Industrial Heater specifications and data.



Wind-tunnel testing in the Lennox Product Development Research Laboratories — to accurately measure CFM capacity — is but one of dozens of factory tests made on every Lennox Industrial Heater.

ON THE SPOT SERVICE

Cities where Lennox sales representatives are located



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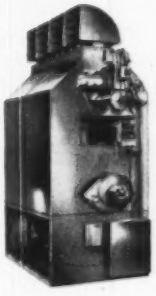

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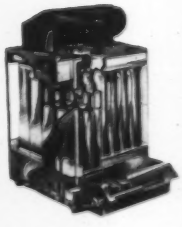
400,000 to 2,000,000 Btuh
Oil, gas or combination fuel



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Please send me — without obligation — complete specifications and engineering data on Lennox Industrial heaters.

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Easy to Install!

Leak-Proof!

Economical!

Maintenance-Free!

Highly Efficient!

Ideal for High-Pressure "Spot-Heating" Installations!

"BUFFALO" BREEZO-FIN UNIT HEATERS

"Buffalo" Breezo-Fin Unit Heaters are your "best buy" for "spot-heating" applications in plants and commercial buildings. Flexible, economical and dependable, they are delivering peak performance in thousands of installations throughout the world.

Best of all, *leakage inside the unit is positively eliminated.* A one-piece, seamless copper tube extends from inlet to outlet ground joint. This provides absolutely leak-tight operation for steam pressures up to 250 pounds and 406° F. Special coils for higher pressures and temperatures can be furnished, on application, utilizing steam or hot water.

Other Breezo-Fin features include high-efficiency fans for quiet operation — streamlined, handsome appearance — fins designed for maximum radiation — sturdy construction for long, maintenance-free life — adjustable louvers to "spot" the heat exactly where it's needed. Available in 31 standard sizes from 16,000 to 497,000 BTU. Special larger packages also available for higher heating loads.

Be sure to investigate "Buffalo" Breezo-Fin Unit Heaters for *your* next "spot-heating" job. Contact your nearby "Buffalo" engineering representative, or write us direct for Bulletin 3137-E.

One of many "Buffalo" Breezo-Fin Unit Heaters installed in world's largest surgical dressings plant, equipped with special coils operating on 425° F hot water with 400 P.S.I. working pressure.

"Buffalo" products bring you the "Q" Factor—the built-in QUALITY that provides trouble-free satisfaction and long life.

"Buffalo"

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Buffalo Pumps Division • Buffalo, N. Y.

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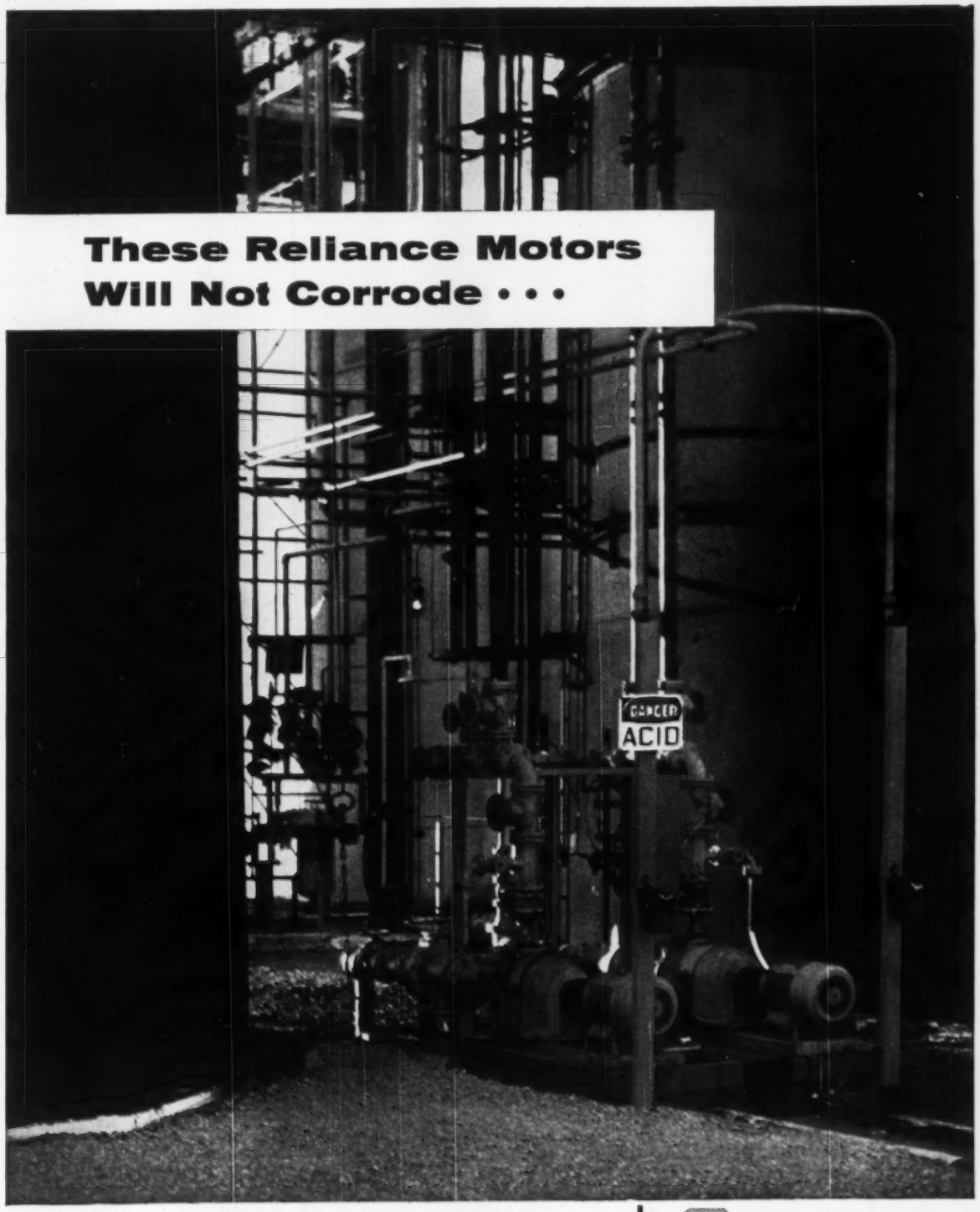
VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING



These Reliance Motors Will Not Corrode • • •

Write for bulletin B-2406 for further information on 1 to 125 hp corrosion-proof motors.

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 3612A CLEVELAND 17, OHIO
CANADIAN DIVISION: TORONTO, ONTARIO
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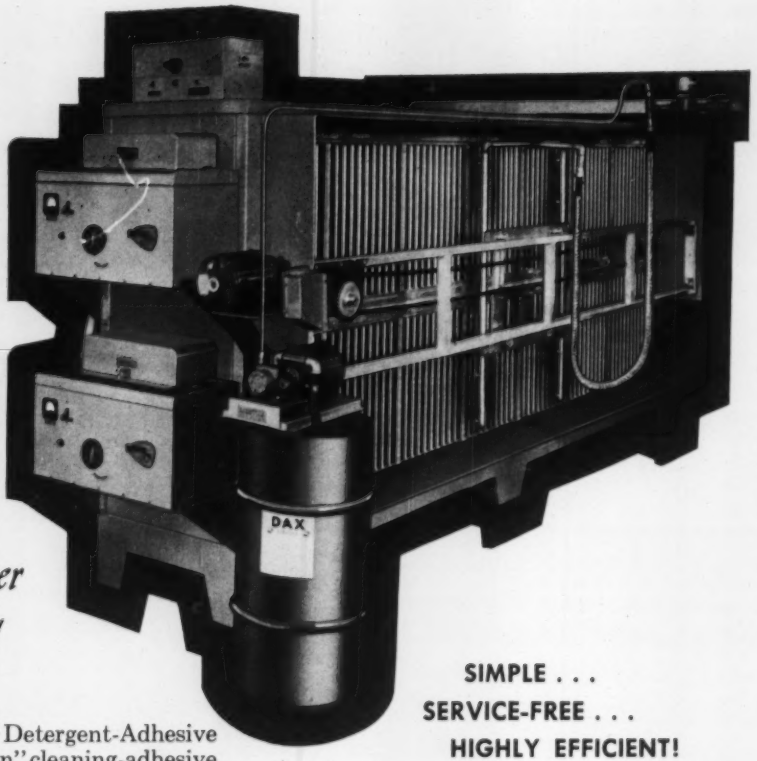
MASTER REEVES

ANNOUNCING NEW ELECTRO-AIR DAX SYSTEM

Now the electronic air cleaner washing problem is solved!



SIMPLE . . .
SERVICE-FREE . . .
HIGHLY EFFICIENT!

With the introduction of the Electro-air Detergent-Adhesive System, Type "X", and its "one operation" cleaning-adhesive solution, DAX, the problem of effectively getting rid of collected contamination on electronic air cleaners is solved.

Before DAX was developed, the advantages of a true electronic air cleaner often were lost because the washing system could not do an effective job of keeping the equipment clean. Air-borne dirt which collects on the electrodes and plates has a greasy texture and could not readily be washed off the collecting cells with just hot or cold water, even when a conventional water soluble oil adhesive was applied after each washing. After a series of washings and adhesive applications, the electronic air cleaner cells became coated with an unsightly black build-up that often led to service problems as well as lowered efficiency.

Electro-air's DAX System solves these problems. One-operation, double-acting DAX, when mixed with wash water, thoroughly washes collecting cells, then dries and leaves a coating on collecting plates and electrodes which serves as an adhesive and also facilitates the next washing.

The Electro-air Detergent-Adhesive System, Type "X", is supplied as a package, and is available with either new Electro-airs or those which have already been installed and are in operation. And it works with either vertical traveling washing systems (shown) or horizontal fixed washing systems.

An Electro-air Electronic Air Cleaner with the DAX cleaning and adhesive application system, is the most efficient . . . the most service-free . . . unit on the market.

Extensive tests prove that the new DAX system offers many advantages over conventional cleaning-adhesive application methods:

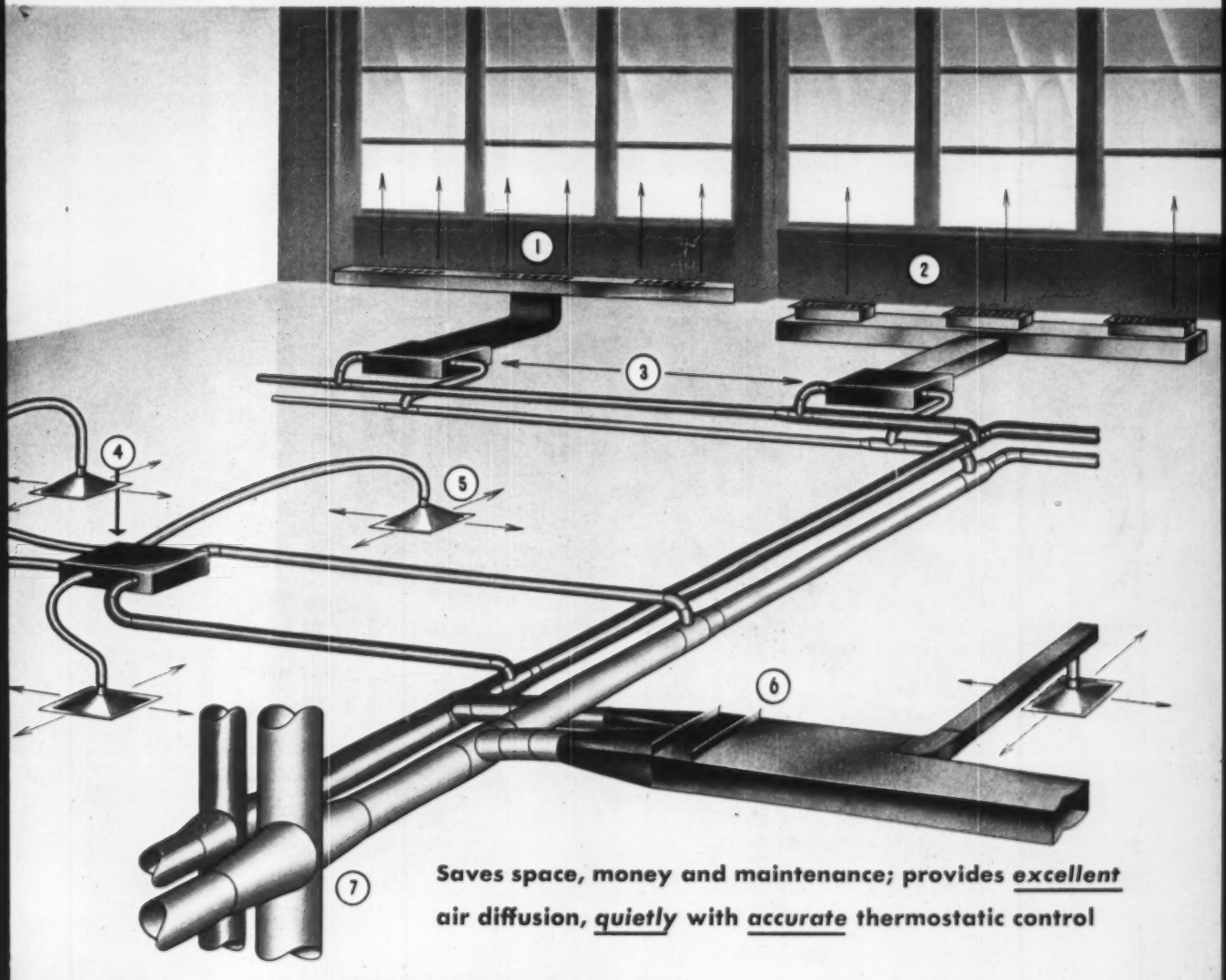
1. Maintenance costs are reduced (DAX costs less than conventional adhesive).
2. Collecting cells are greatly improved in appearance . . . they stay free from build-up of contamination.
3. Arcing, due to dirt accumulation, is eliminated.
4. Efficiency is improved . . . there are no "voltage leaks" resulting from dirty insulators.
5. Drain pans and ducts remain clean . . . there is no accumulation of dried adhesive.
6. Service problems due to dirt build-up are eliminated!

ELECTRO-AIR
ELECTRONIC AIR CLEANERS

ELECTRO-AIR CLEANER CO., INC.
Olivia and Sproul Streets
McKees Rocks, Pa.

SEND FOR FREE LITERATURE
which gives complete technical information on DAX

The New Anemostat "FLEXECONOMY" System for flexible, economical air conditioning



Saves space, money and maintenance; provides *excellent* air diffusion, *quietly* with *accurate* thermostatic control

1. The New Anemostat Diffus-A-Curb — A high induction diffuser (4″ high x 6″ wide) of rugged stainless steel construction. Provides excellent air diffusion throughout 20 foot exterior zone spaces during both cooling and heating seasons.

or

2. The New Anemostat Stainless Steel Diffus-A-Plate — Diffusion characteristics and performance same as Diffus-A-Curb. Rugged construction to withstand heavy traffic. Provides more effective rentable area. High velocity air streams minimize dirt accumulation in duct.

3. Anemostat Constant Volume High Velocity Units — Automatically controlled by thermostats in the occupied spaces.

4. Anemostat Octopus High Velocity Units—Available for interior spaces where individual controls are required.

5. Anemostat Air Diffusers—Available in any type for high velocity units — square, round, rectangular or perforated plate — to match special or standard type ceilings. Diffusers are available to suit architect's specification.

AC-1384

6. New Anemostat Standardized Constant Volume Turbulators — Provide zone controls for spaces up to 7000 square feet in area. Accurately maintain temperature and air volume in the space at pre-determined ratings. Controlled by a thermostat in the zone or in return air duct from zone.

7. High Velocity—High Temperature Differential Ducts (Up to 6000 ft. per minute velocity—up to 30°F differential) — One set of ducts serves both interior and exterior zones. Sized for one solar load because cooling effect is shifted automatically by Anemostat High Velocity Units as sun effect moves from east to west. Duct sizes and duct spaces are reduced by capitalizing on probability factors and modern automatic controls.

ANEMOSTAT®

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10 East 39th Street, New York 16, N. Y.

RECOLD

Engineering the temperature...

AROUND THE WORLD...

Bangkok, Thailand. In oppressive heat and sweltering humidity the luxurious Erawan Hotel is completely cooled by Recold air conditioning equipment. Horizontal and vertical air handling units cool the public rooms. Small RE room units, individually controlled, cool and dehumidify each of the 206 apartments and bedrooms.

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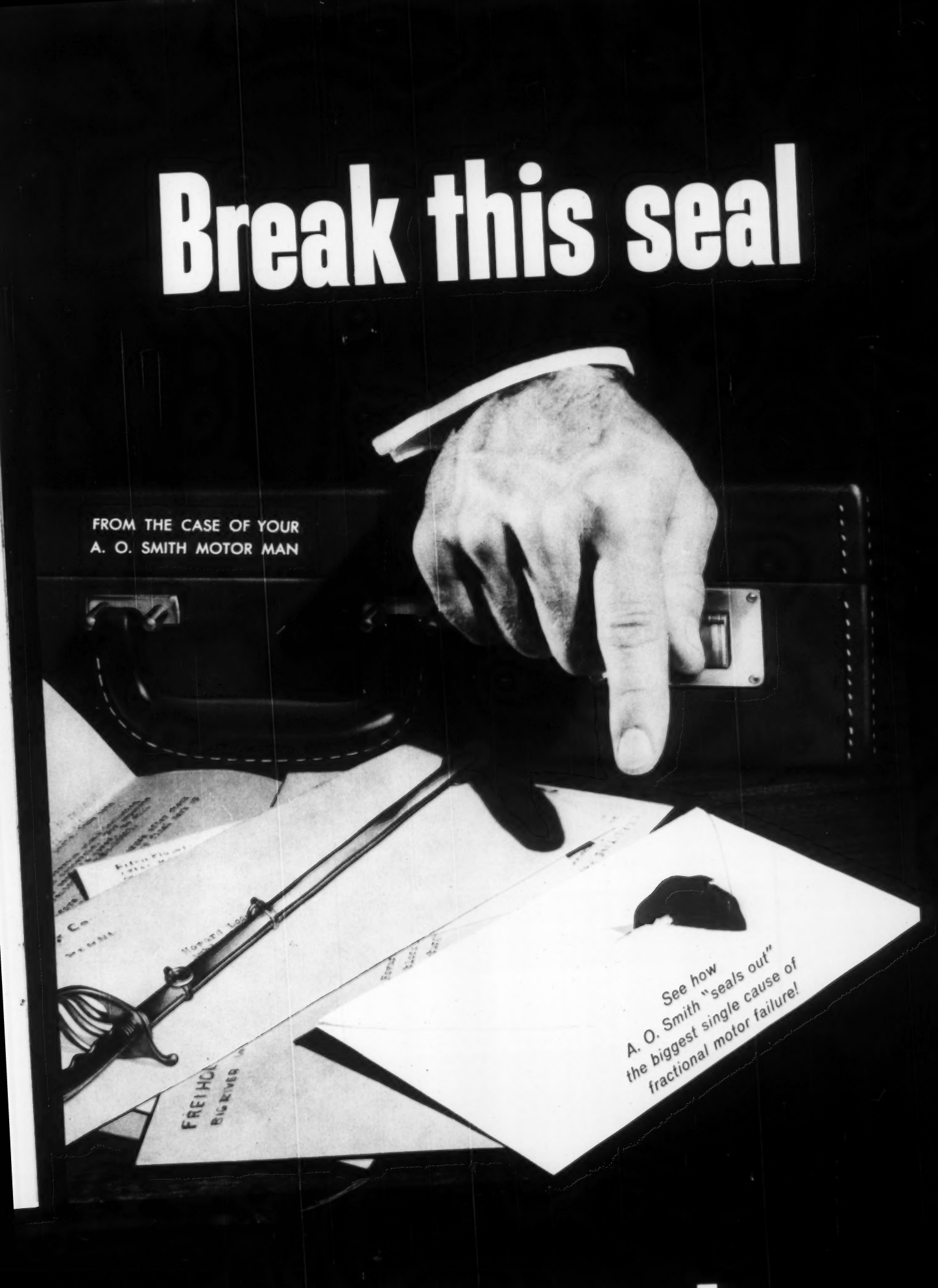
First major breakthrough in fractional hp motor design...

Break this seal

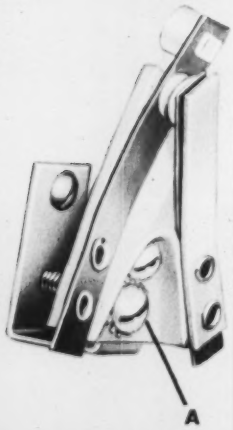


First major breakthrough in fractional hp motor design...

revolutionary new

...for switch, actuator, capacitor, thermostat and terminal board

1. Seals out dirt, lint, insects and other matter. Ventilating air *cannot* contaminate these vital parts.
2. Provides complete protection against mechanical damage.
3. Sealed capacitor and terminal board assures easy, all-position mounting. Absence of externally mounted capacitor* "dog house" and conduit box permits installation anywhere and in any position.
4. Bearings are prelubricated and sealed. Require *no* lubrication for the life of the motor.
5. Finally . . . ball bearing motors as quiet as sleeve bearing motors.
   - **A.** No more "book-end" bearings. New design permits much closer bearing centers.
   - **B.** Super-honed close tolerance bearings.
   - **C.** Magnetic noises reduced to absolute minimum by special machining and assembly processes.
   - **D.** Air noise practically eliminated through unique ventilation design.
6. Single phase motors with the new sealed starting switch are available from ⅓ to 5 hp. Included are specific designs for blowers, pumps, compressors, machine tools, and material handling equipment.

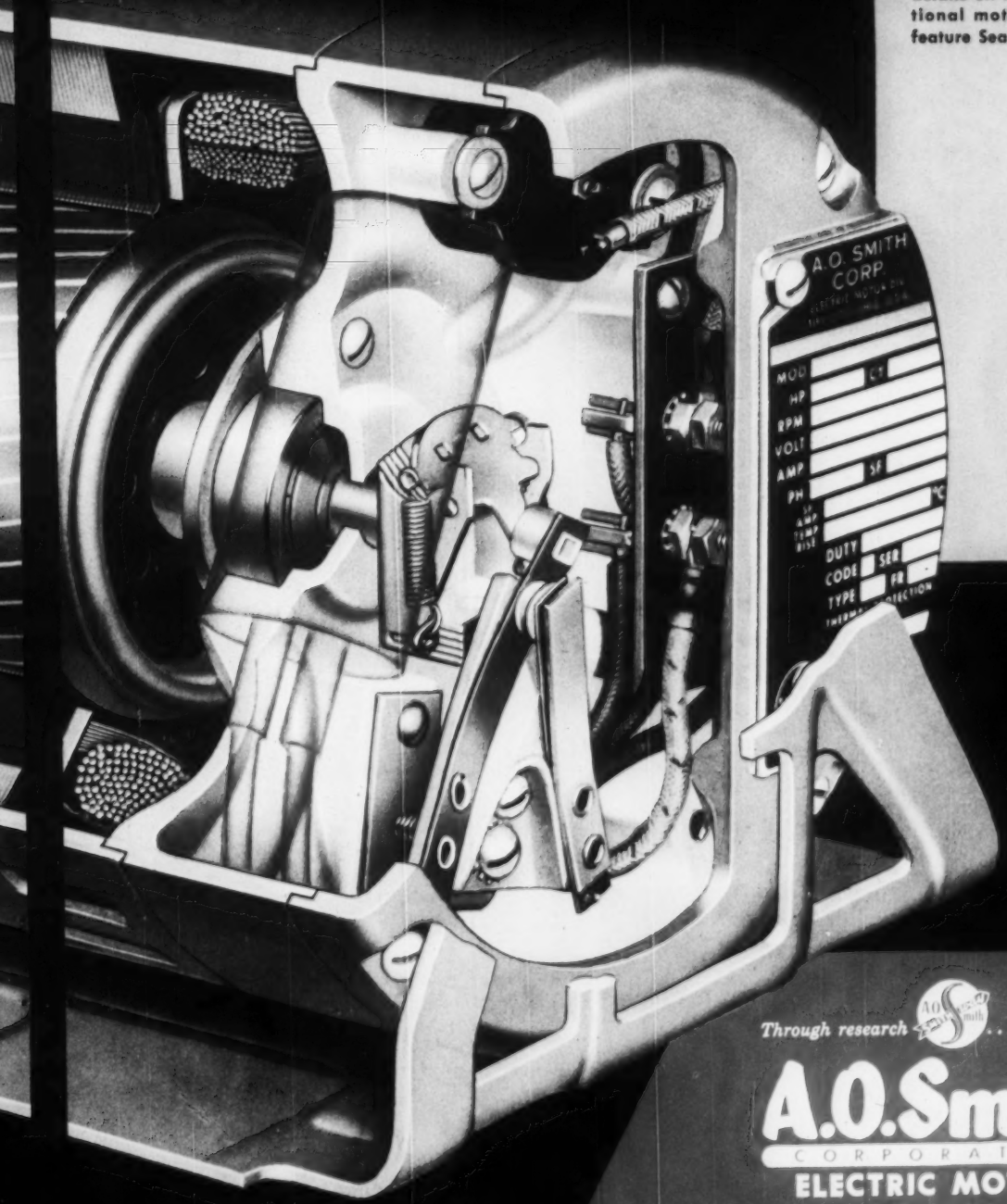


Adjustable starting switch

Every A. O. Smith single-phase motor features the new *exclusive* adjustable starting switch. The vital switching action is no longer dependent on a build-up of tolerances throughout the motor. On *every* motor the switch is adjusted *after assembly* by turning the self-locking screw (A) to achieve a preset clearance between the switch button and the actuator. This setting assures proper contact alignment and positive switching action . . . guaranteeing maximum life for *every* motor. Field adjustments and/or replacements are just as easy.

**Capacitor is internally mounted on motors rated 1 hp, 3600 rpm and 3/4 hp, 1800 rpm and smaller.*

sealed capsule



Please send me more comprehensive details on the A. O. Smith line of fractional motors — ⅓ to 2 hp — that feature Sealed Capsule design.

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Rigid or resilient base models available.

Through research ...*a better way*

A.O.Smith

CORPORATION

ELECTRIC MOTORS

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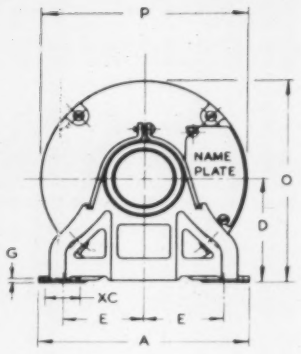
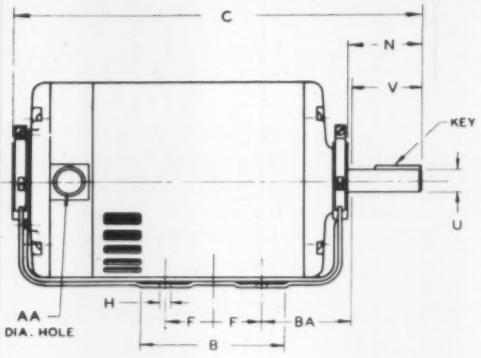
NEW...
"SEALED CAPSULE"
FRACTIONALS

RIGID AND RESILIENT BASE





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ELECTRIC MOTORS
531 North 4th Street
TIPP CITY, OHIO

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Tipp City, Ohio
Permit No. 83

FRAME SIZE	DIMENSIONS IN INCHES										
	A	rigid B	resiliant B	C	D	E	F	G	H	N	O
56-1	6 1/2	4 3/4	4	11 3/16	3 1/2	2 7/16	1 1/2	5/32	11/32	1 15/16	6 11/16
56-2	6 1/2	4 3/4	4	12 3/16	3 1/2	2 7/16	1 1/2	5/32	11/32	1 15/16	6 11/16
56-3	6 1/2	4 3/4	4	12 11/16	3 1/2	2 7/16	1 1/2	5/32	11/32	1 15/16	6 11/16
56-4	6 1/2	4 3/4	4	13 3/16	3 1/2	2 7/16	1 1/2	5/32	11/32	1 15/16	6 11/16
56-5	6 1/2	4 3/4	4	14 3/16	3 1/2	2 7/16	1 1/2	5/32	11/32	2 5/16	6 11/16
56-6	6 1/2	4 3/4	4	15 1/16	3 1/2	2 7/16	1 1/2	5/32	11/32	2 5/16	6 11/16

FRAME SIZE	DIMENSIONS IN INCHES						
	P	U	V	AA	BA	XC	KEY
56-1	6 3/8	5/8	1 3/4	.859 .864	2 3/4	1 7/32	3/16 x 3/16 x 1 3/8
56-2	6 3/8	5/8	1 3/4	.859 .864	2 3/4	1 7/32	3/16 x 3/16 x 1 3/8
56-3	6 3/8	5/8	1 3/4	.859 .864	2 3/4	1 7/32	3/16 x 3/16 x 1 3/8
56-4	6 3/8	5/8	1 3/4	.859 .864	2 3/4	1 7/32	3/16 x 3/16 x 1 3/8
56-5	6 3/8	3/4	2 1/4	.859 .864	2 3/4	1 7/32	3/16 x 3/16 x 1 7/8
56-6	6 3/8	3/4	2 1/4	.859 .864	2 3/4	1 7/32	3/16 x 3/16 x 1 7/8

BLOWER MOTORS RESILIENT BASE

HORSEPOWER	1/3	1/3	1/2	1/2	3/4	3/4	1	1	1 1/2	2
R.P.M.	3600	1800	3600	1800	3600	1800	3600	1800	3600	3600
FRAME SIZE	56-1	56-1	56-1	56-2	56-2	56-3	56-3	56-5	56-5	56-6

GENERAL PURPOSE RIGID BASE

HORSEPOWER	1/3	1/3	1/2	1/2	3/4	3/4	1
R.P.M.	3600	1800	3600	1800	3600	1800	3600
FRAME SIZE	56-1	56-1	56-1	56-2	56-2	56-3	56-3

Through research ... a better way

A.O.Smith
CORPORATION
ELECTRIC MOTORS
531 North 4th Street
TIPP CITY, OHIO

Bulletin MM-165

Litho in U.S.A.

How Centralized Remote Control Completes an Air Conditioning System

With centralized remote indication, adjustment, and recording, the system accomplishes what it is designed to do... costs less to operate and maintain ... and delivers continuous complaint-free comfort

Complaints about room temperatures usually are a result of poor *management* of the heating-ventilating-cooling system.

When controls are located in the various controlled zones, proper adjustment is time-consuming, sometimes very difficult, and often neglected. The problem becomes next to impossible of solution when occupants have access to thermostat adjustments.

Remote Control is Answer

Complete centralized remote control — indication, adjustment, and recording — provides simplified and centralized system management. It *completes* the system, assuring the continuous, uniform comfort for which the system was specified and purchased in the first place.

One man can supervise the entire installation. Immediate response is provided to tenants' requests for more or less heat. The constant up-and-down temperature pattern common in building areas where everyone has access to the thermostat is eliminated.

Additionally, remote control centers provide immediate detection of faulty operation so that corrective action can be taken before complete failure occurs.

Electronic Remote Control

The benefits and costsavings of centralized remote control are apparent in Barber-Colman Electronic Control Centers.

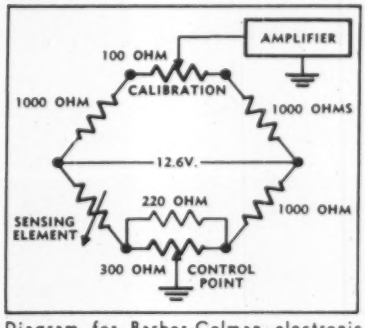
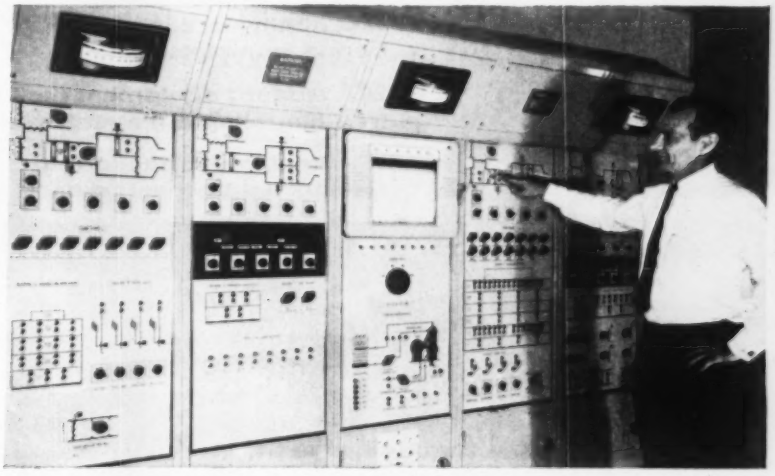


Diagram for Barber-Colman electronic temperature controlling circuit as used in Electronic Control Centers. Ask for "Electronic Control Story" booklet.

Operation is simple and maintenance cost is negligible. Floor layouts and systems are shown schematically on the panel. By pushbutton control, the operator can instantly read on an indicating thermometer the temperature at any remote location. Temperature adjustment is made instantly by means of convenient control switches. Multi-point temperature recording instruments can be provided for analysis of system operation.



Five-panel Barber-Colman Electronic Remote Control Center at International Mineral & Chemical Corporation, Skokie, Illinois. The center provides control for all major fans and circulating pumps and permits remote temperature indication and adjustment for all zones throughout five interconnected buildings. A multipoint recorder is provided for system analysis and permanent recording of equipment performance for future reference. *Architect and engineer: Perkins & Will, Chicago, Ill. Mechanical Contractor: M. J. Corboy Corp., Chicago, Ill. Air Conditioning and Ventilating Contractor: Robert Irsay, Skokie, Ill.*

Remote Temperature Sensing. Instead of conventional electric thermostats, electronic room thermostats are used. They have no moving parts and will last indefinitely. They consist of a coil of wire through which a small current flows. Changes in room temperature change the coil resistance. Resulting changes in current flow unbalance a bridge circuit in the control center, actuating an electronic temperature controller.

Electronic Temperature Controllers. Barber-Colman electronic temperature controllers are the simplest and most dependable available. They include a single microrelay which requires 1000 times *less* power than that required by ordinary relays. As a result, the current from the sensing circuit can be amplified by only two commercial-type "radio" tubes. The load imposed on these tubes is so light that a life of five years or more is common. Tubes and relay are of the plug-in type for simple servicing.

Electric Motor Operators. The relays in the temperature controllers close circuits which position electric motor operators to actuate valves, dampers, or program switches for accurate, automatic system control.

Override Switch. In event of failure of an electronic controller, an override switch allows the individual motor operator to be adjusted manually until repairs can be made. One circuit cannot cause complete system failure.

Simpler Installations

Not only does centralized remote control provide simpler operation and maintenance, it also makes the designers' and installers' jobs easier. All conduit and wiring are run to one central point for hookup to the factory-assembled Electronic Control Center. The only remotely located elements are the dependable room thermostats and motor operators. All other circuitry is located at the control panel where it is easy to get at.

For additional information ask for Bulletin F-8944. Call your local Barber-Colman field office or write:

BARBER-COLMAN COMPANY

Dept. L, 1301 Rock Street, Rockford, Illinois

BARBER COLMAN

Automatic Controls

See us at the ASHAE Show
Philadelphia – Jan. 26-29
Booth No. 118 & 122

THE MARK OF QUALITY

BARBER COLMAN

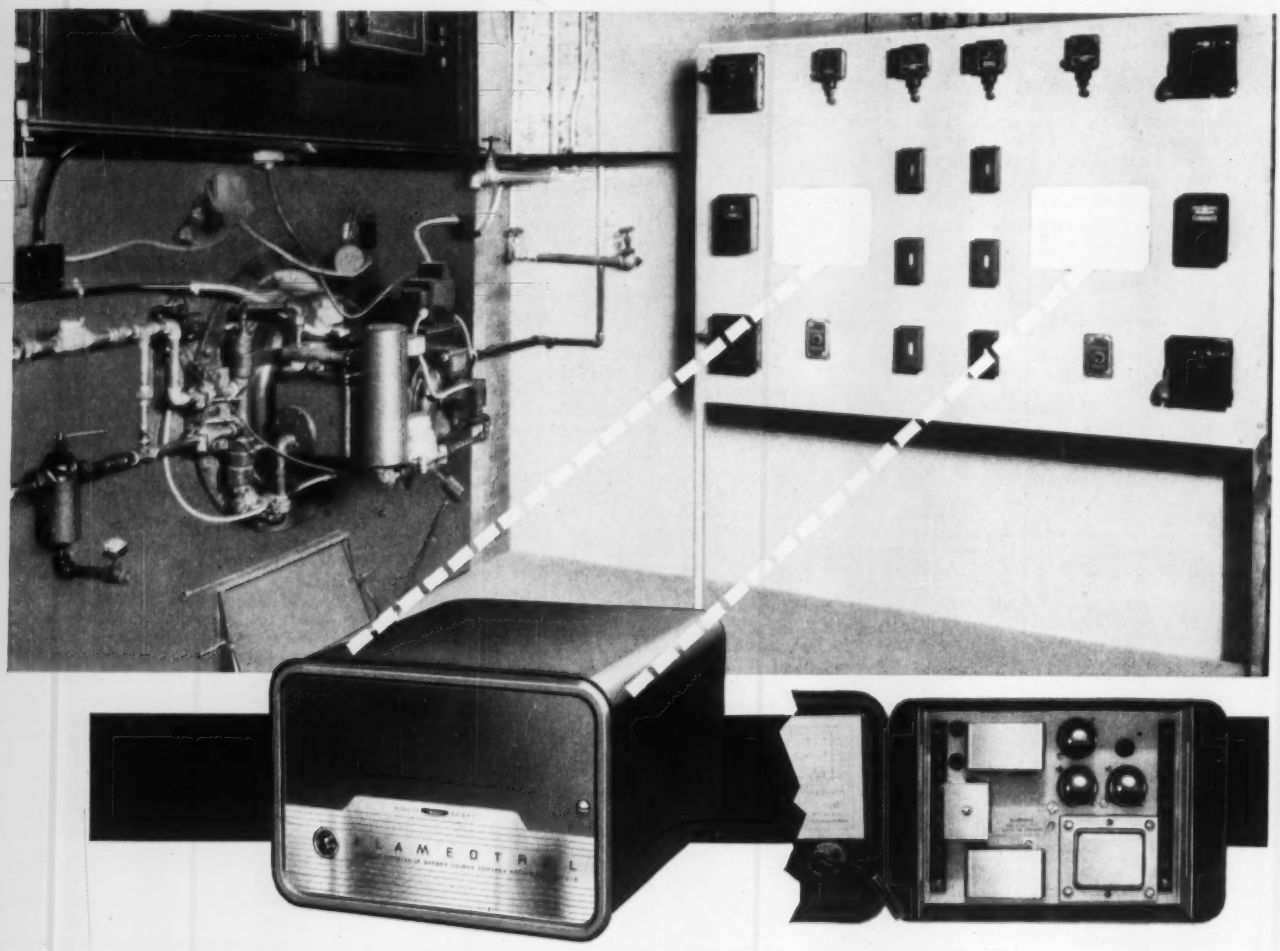
Wheelco Instruments

Look for all these features when choosing combustion safeguards

1. Ability to choose the best system for your needs from a complete line

2. Modern equipment designs to insure long trouble-free life, simple inspection and maintenance

3. Equipment backed up by a nationwide, thoroughly trained field organization



Pushbutton-start Flame-otrols, like the one shown here, are available with a Series 1470 Conductivity-Rectification system or a Series 1570 Infra-Red system.

Convenient external test points for checking circuits and voltages with conventional test instruments. Electronic tubes are standard types simplifying replacement.

write for literature describing Wheelco Flame-otrols

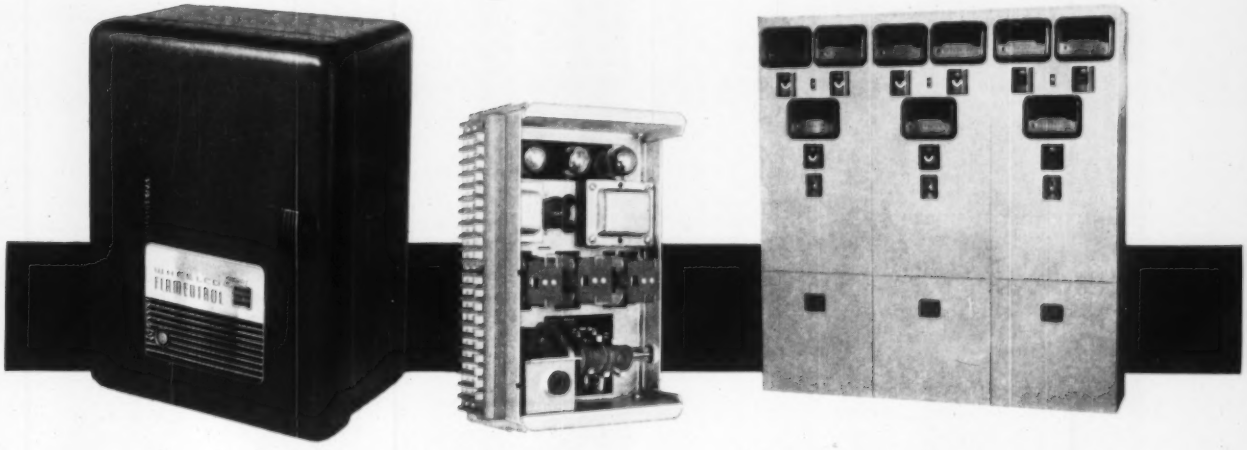
Unless your combustion safeguard system provides all these features you may be making an expensive and needless sacrifice. Wheelco Flame-otrols meet all these requirements whether the application be on a boiler, furnace, kiln, or dryer, and provide them at the cost of conventional equipment.

One Is Best — Wheelco offers two automatic operation and two pushbutton-start Flame-otrols to provide the exact system and the degree of control needed for a particular installation. Either Conductivity-Rectification "CR" systems or Infra-Red "IR" systems are used to monitor the flame. IR systems use a lead sulphide photoconductive cell as the sensing element, while CR systems use flame rods and emissive-type photo cells.

Easy Maintenance — With Wheelco's justly famous plug-in design, inspection and maintenance are easier and faster. The entire chassis may be removed for examination, adjustment, or repair. Standard electronic tubes are used throughout simplifying replacement from local stocks and cutting inventory needs. Wheelco's practical design permits Flame-otrols to be installed in every type of plant location by housing them in rugged, industrial-type steel cabinets provided with a gasketed, dust-tight, swing-out cover.

Control Centers Too — Custom-engineered installations that house a complete combustion safeguard system including Flame-otrols, pilot lights, alarms, etc., have long been a Wheelco specialty. These attractive centralized packages reduce installation costs and time, yet are provided with removable sections that offer flexibility for changing requirements.

Field Engineering Help — It pays to bring the Wheelco field engineer in on your planning when combustion safeguards are needed for a new or modernized installation. His experience plus the availability of a full line of instruments is your assurance of getting the system best suited to your needs. Wheelco field engineers are located in all principal cities, are as close to you as your telephone. This nationwide network, plus specialists in the home office, is always available to help you with your problems.



External and internal views of super-duty automatic Flame-otrols. Programing of these units includes purging, warm-up proving, pilot proving, low-fire stabilization, ignition timing and post-purging.

Custom-engineered Wheelco control centers can incorporate a wide variety of features. Either pushbutton-start or automatic Flame-otrols can be provided.

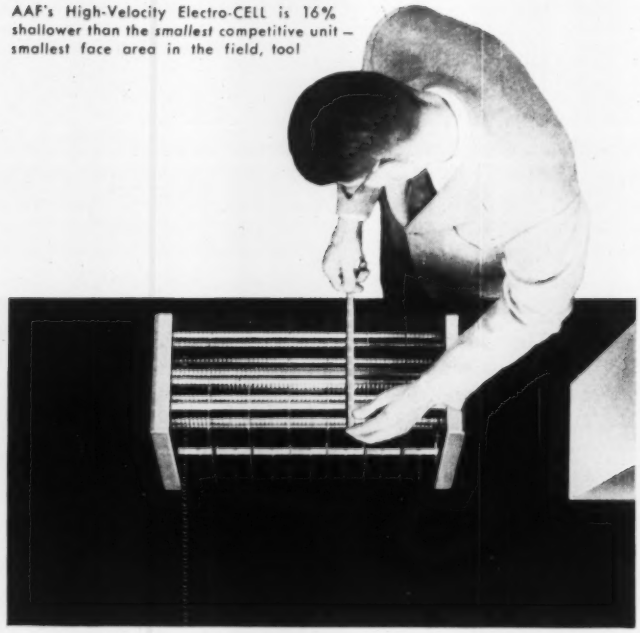
BARBER-COLMAN COMPANY

Dept. L, 1501 Rock Street, Rockford, Illinois, U.S.A.
BARBER-COLMAN of CANADA, Ltd., Dept. L, Toronto

Industrial Instruments • Automatic Controls • Air Distribution Products • Aircraft Controls • Electrical Components
Small Motors • Overdoors and Operators • Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

AAF *Electro*-CELL . . .

AAF's High-Velocity Electro-CELL is 16% shallower than the *smallest* competitive unit — smallest face area in the field, too!

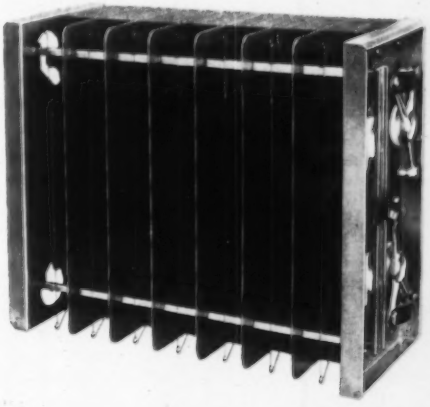


cleaner air
in a smaller package
at lower cost

COMPARE THESE FEATURES WITH THOSE OF ANY OTHER HIGH-VELOCITY PRECIPITATOR

- Does super-cleaning job at higher velocities than any other unit!
- Shallower, smaller in face area. Requires less space than any other high-velocity precipitator!
- Completely automatic maintenance. Automatic washing schedule can be set to meet the needs of each individual job!
- Uses less power than any other high-velocity precipitator!
- Design eliminates by-pass areas within collector cell!
- Precipitator's face area and velocity equal to coil face area and velocity!
- The only electronic precipitator having all insulators out of air stream!
- Only electronic precipitator in which damaged plates can be replaced!
- Any one cell can be removed without disturbing other cells!
- Also available in high velocity, wide-space plate design for heavy industrial service.

. . . the only REALLY NEW High-Velocity Electrostatic Precipitator



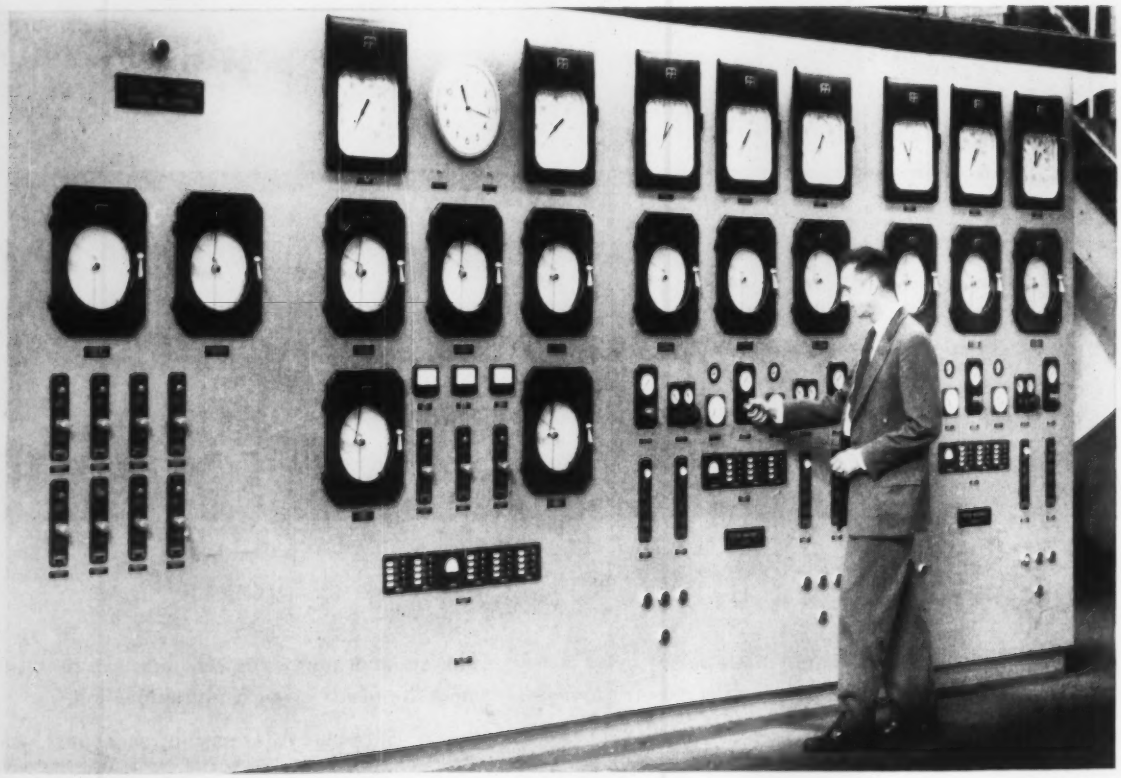
THIS most recent product of AAF air filtration research is all new—*designed for* high velocity work, not *adapted to* it!

The new Electro-CELL operates at higher velocities — delivers higher efficiency — requires less space (16% shallower) than any other precipitator. And maintenance is a snap. The automatic washing schedule can be set to meet the needs of each individual job.

For complete information, see your local AAF representative or write us direct for Bulletin 258. Address: Mr. Robert Moore, American Air Filter Company, Inc., 373 Central Avenue, Louisville, Kentucky.

AAF **American Air Filter**
BETTER AIR IS OUR BUSINESS

CAPITOL HILL RECORDS COOLING



Central Supervisory Panel for Capitol Power Plant cooling system, Washington, D. C. Variables recorded by Taylor instruments include: Condenser Water Temperature and Flow; Outdoor Temperature and Humidity; Tons of Refrigeration; Chilled Water Flow in both East and West Tunnels; and Chilled Water Temperature and Pressure.

The Taylor Multiplying Linkage System multiplies temperature differential and flow to give tons of refrigeration, enabling the operator to evaluate the performance of the entire cooling plant from this master panel.

Taylor Instruments

EFFICIENCY WITH TAYLOR INSTRUMENTS

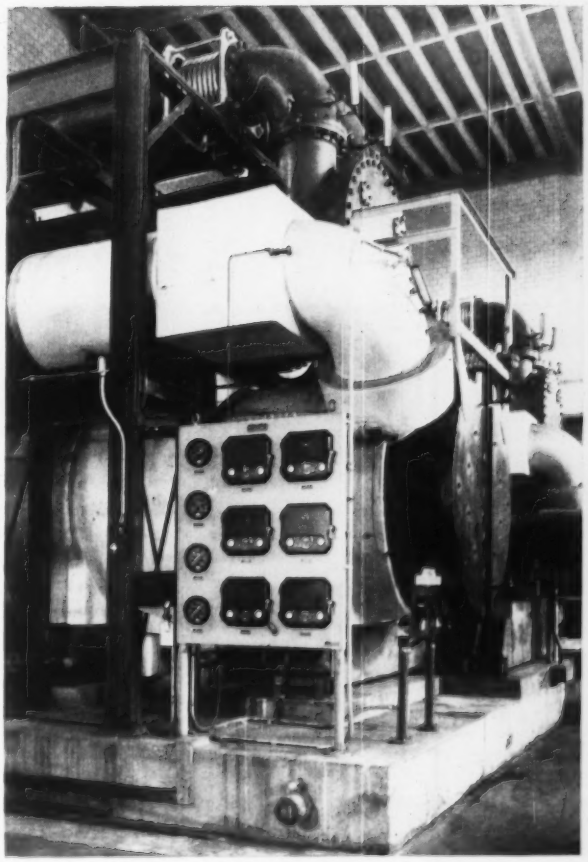
TAYLOR instruments at the Capitol Power Plant perform two important functions. They indicate and/or record the BTU performance of the cooling system on a central supervisory panel, thus enabling the operator to run the plant at maximum efficiency.

The new Capitol System has been in operation for over a year now, and the Power Plant Supervisor reports complete satisfaction with the performance of the equipment and the instrumentation. The new installation uses four York centrifugal compressors to provide 8800 tons of refrigeration to seven large government buildings. This is piped via a two-mile underground tunnel containing about 600,000 gallons of 40°F. chilled water which is circulated at a rate of 26,400 gpm.

Under the prime contract of Standard Engineering of Washington, D. C., Inc., the instrumentation was installed by Johnson Service Co., to plans drawn up by Consulting Engineer Guy B. Panero.

When you need air conditioning for human comfort or industrial processing requirements, there is a Taylor system that will ensure years of dependable, trouble-free performance. See your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester 1, N. Y., or Toronto, Ontario.

For Vision . . . Ingenuity . . . Dependability in solving your process control problems.



One of the four Compressor Transmitter panels at the Capitol Power Plant. Taylor Potentiometer Transmitters are used to obtain differential chilled water temperatures. Temperature and flow readings are transmitted to the Master Panel (*shown at left*) by TRANSVERTER* Transmitters. These transmitters have a wide range—from 10% to 100% of flow—and measure with an accuracy of ±1% of flow.

*Trade-Mark

MEAN ACCURACY FIRST

WHEELS

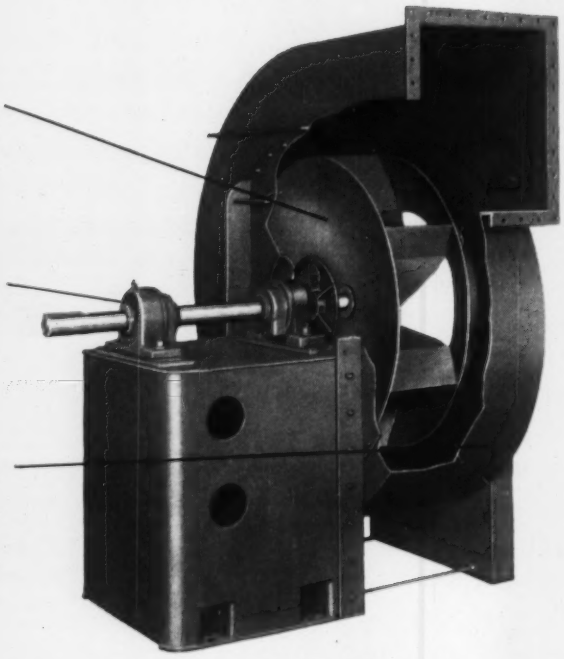
Welded steel construction. One-piece, cone-shaped rims and hubplates, standard or extra-heavy.

BEARINGS

Heavy-duty, self-aligning ball or tapered roller bearings for quiet operation, dependability, long life.

HOUSINGS

Heavy welded sheet steel or plate, adjustable discharge in sizes thru 37" inlet. Fixed discharge on larger sizes. Externally braced for maximum rigidity.



AIR HANDLING
Type AH

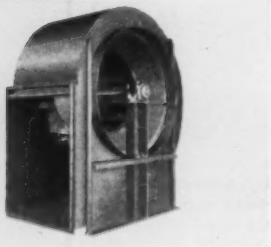
MATERIAL HANDLING
Type MH

LONG SHAVINGS
Type LS

Handle any one of 3 basic processes with an American Blower Industrial Fan

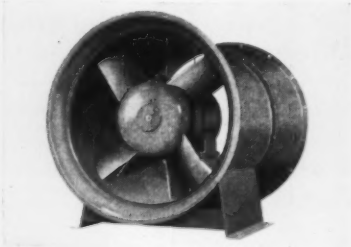
Here's a practical way to solve tough process applications: an American Blower Industrial Fan. It's available with three types of wheels to let you handle air, gases, or air and gases containing material, or long shavings. And there's a wide range of fan arrangements, optional constructions — for severe duties or high-temperature operations — and optional accessories to allow fan modification for individual jobs. Equipment selection and application assistance is available, should you need it, from our 73 engineer-staffed branch offices. A phone call is all it takes to get full product information. American-Standard,* American Blower Division, Detroit 32, Mich. In Canada: Canadian Sirocco products, Windsor, Ontario.

It pays to standardize on American Blower fans for every duty!



HS Fans—direct or V-belt drive, medium-speed operation; nonoverloading.

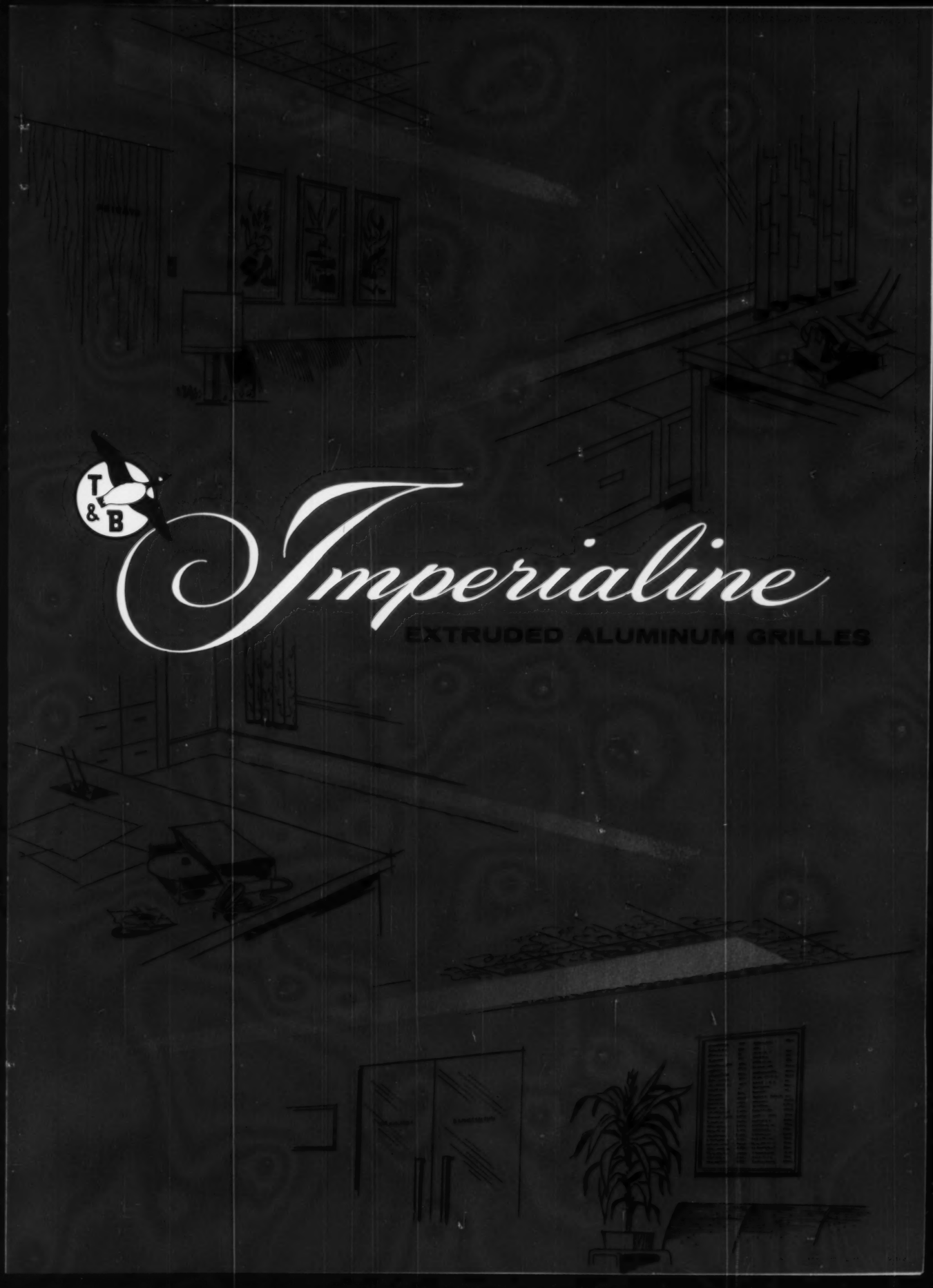
Sirocco Fans—low speed, quiet operation; move more air per revolution.



Axial Fans—move high volumes in minimum space; flexible installation.

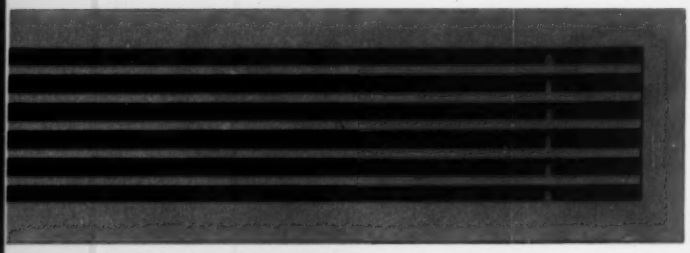
* American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard
AMERICAN BLOWER DIVISION

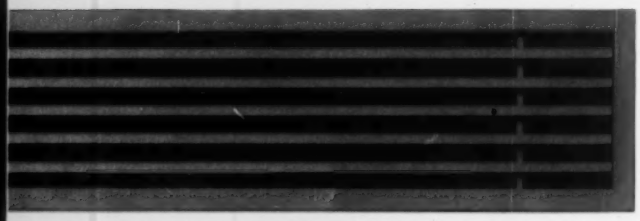

T&B
Imperialine
EXTRUDED ALUMINUM GRILLES

Imperialine

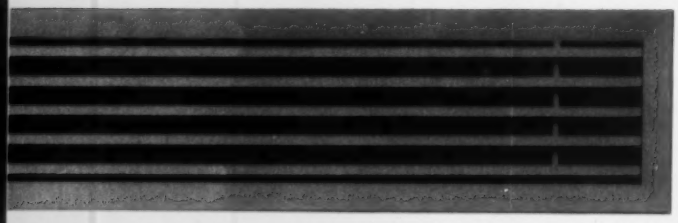
EXTRUDED ALUMINUM GRILLES



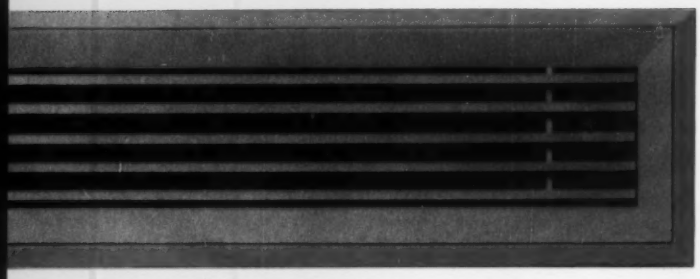
¾" FLAT MARGIN



⅜" FLAT MARGIN (FLUSH)



½" BEVELED MARGIN (FLUSH)



1" BEVELED MARGIN

Featuring trim, attractive straight-line styling, Tuttle & Bailey's IMPERIALINE Extruded Aluminum Grilles are the answer to architectural demands for air distribution equipment that will harmonize with, or accent, linear design concepts. Universal in application, where fixed bar settings meet performance requirements, they may be used on the supply or return portions of heating, cooling or ventilating systems and are ideal for ceiling, sidewall, floor or sill installation.

IMPERIALINE Grilles can be supplied as single units up to 72" in length or as butted sections where long, continuous runs are desired. They are available in widths of 1½", 2", 3", 4", etc., up to 18". The standard flat and beveled margin designs are shown at left.

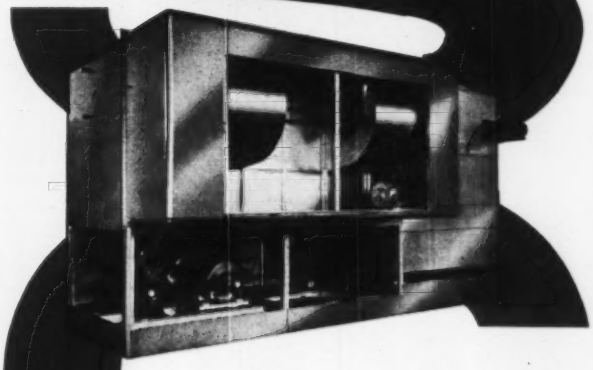
Grille bars can be furnished set straight, deflected 15° or 30°. Adjustable rear deflection bars and face-operated volume control dampers are available.

For complete information, see your nearest Tuttle & Bailey Representative or write us direct.

TUTTLE & BAILEY

division of Allied Thermal Corp. New Britain, Connecticut

S ISFABRICATE[D] Your Requirements . . .

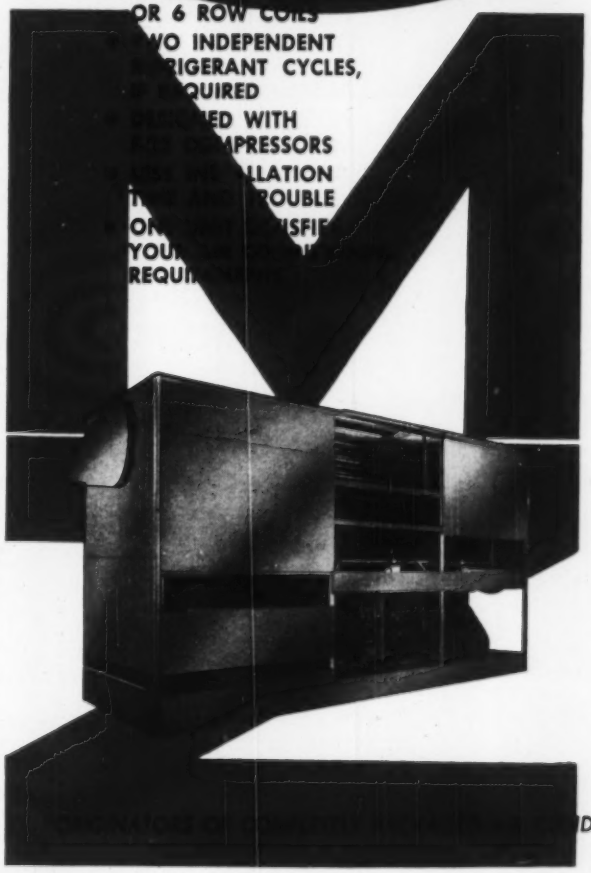


GOVERNAIR'S NEW

Self Contained Multi-Zone Conditioners . . . Type SCMZ

RTANT FEATURES:

- EITH[ER] OR 6 ROW COILS
- [T]WO INDEPENDENT [REF]RIGERANT CYCLES, [NOT] REQUIRED
- [FURNISH]ED WITH [HERM]ETIC COMPRESSORS
- [FACTORY] INSTALLATION
- [MINIMIZE] TROUBLE
- [PROVIDE] SATISFIE[D] YOU[R] REQUI[REMENTS]



The new SCMZ is designed for complete flexibility . . . provides the desired latitude necessary to meet the exacting requirements and unusual space limitations not available in the majority of today's mass produced, unalterable packaged conditioners.

Governair's "Satisfabricated" Self Contained Units have all the basic components of a complete air conditioning system, conditioner section, compressor section, and evaporative condenser section. In these units all refrigerant piping and electrical connections are completed internally by factory-trained craftsman, and carefully supervised to assure proper operation on the job. Simple connection of duct work, electrical, make-up water and drain provide fast and economical installation.

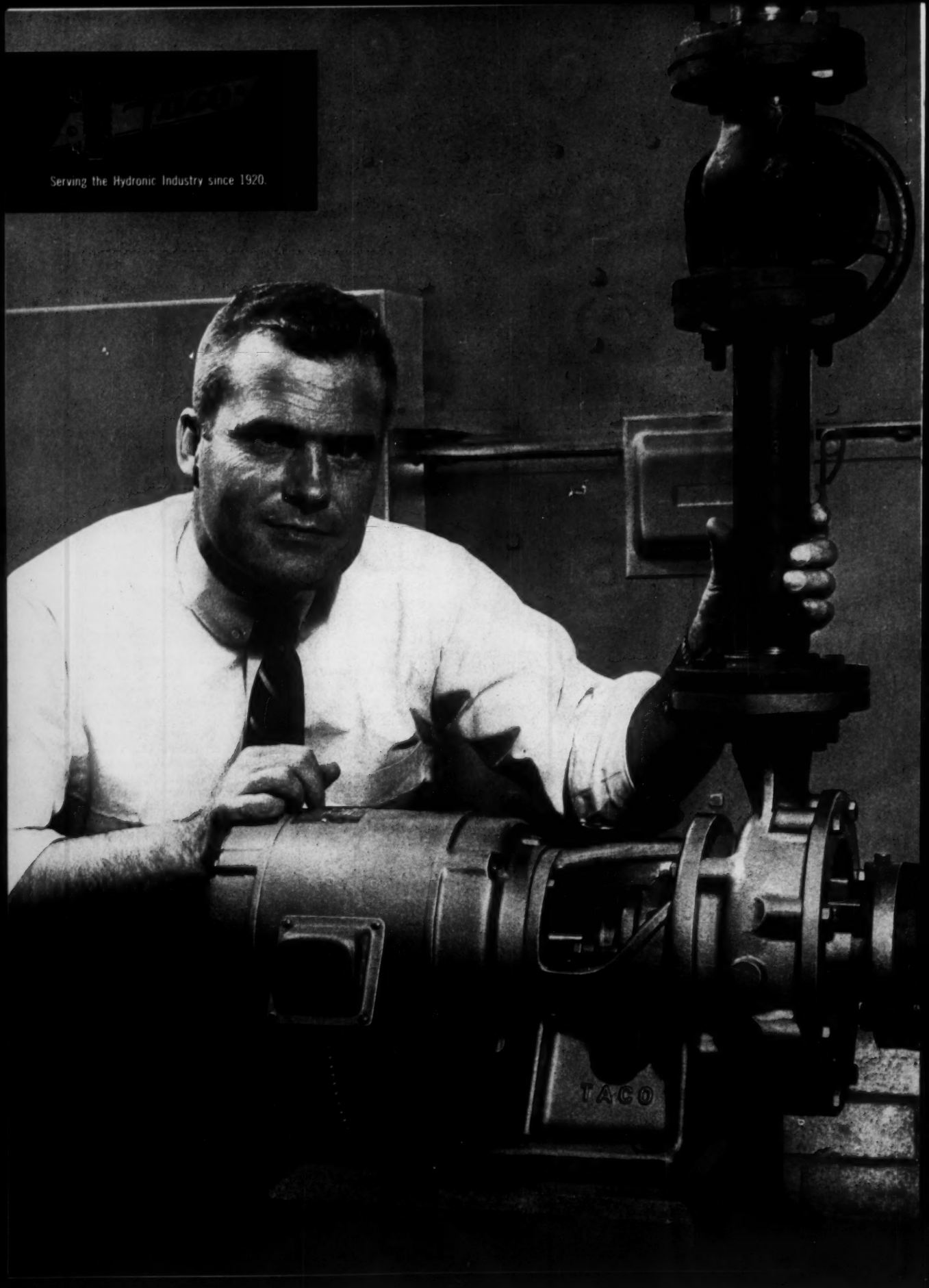
Get Full Details Now

GOVERNAIR CORPORATION

4840 North Sewell

Oklahoma City, Oklahoma

[CONDI]TIONERS"


Serving the Hydronic Industry since 1920.
TACO

NEW from TACO

A LINE OF SINGLE STAGE CENTRIFUGAL PUMPS YOU DESIGNED!

On-the-job discussions with hydronic engineers, contractors and O.E.M. system designers . . . men who know what's needed in a pump . . . were basic factors in the final design and performance features of the new Taco LP pumps!

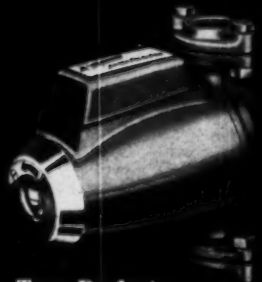
Here stated generally are the main features: rugged design; relatively few sizes; broad range of performance; high efficiencies; interchangeability of parts; available with stuffing boxes or mechanical seals. Also with special motor for extra quiet operation. For the specifics of this dynamic new pump series, write today for the Taco LP Pump Catalog.

Now, as in the past, "NEW from TACO" means the latest in better products for better pumping installations.

TACO HEATERS, INCORPORATED

1160 CRANSTON STREET, CRANSTON 9, RHODE ISLAND

Corporate Office: 342 Madison Avenue, New York 17, New York.
In Canada: Taco Heaters of Canada, Ltd., 4 Gilead Place, Toronto 2.



Taco Perfecta: the world's finest circulator, so quiet you won't believe it's running.

Taco Circulators: packed with quiet power and proven performance, sizes ¼" through 3".

Taco 170 Centrifugal Pumps: perfect for cooling tower jobs, air conditioning installations. . . . wherever a small, top quality centrifugal pump is needed.

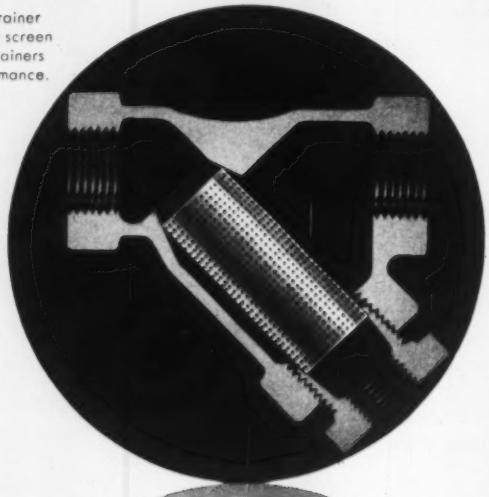
protect your equipment against scale and dirt

Exterior view of NEW Sarco Type "AT" Pipe Line Strainer. Note 45° blow-down angle to facilitate piping away from strainer.

with this

NEW SARCO TYPE "AT" PIPE LINE STRAINER

Cutaway of NEW Sarco Type "AT" Strainer shows sediment collection chamber below screen. Standard screen used in Sarco "AT" Strainers is key to their uniformly successful performance.



Examine one of the new Sarco Type "AT" Strainers and you'll notice at once that its design is a marked improvement over that of contemporary strainers . . . in three important ways:

The Sarco screen, key element of the unit, fits tightly into a long, tapered screen seat. This feature absolutely stops the by-passing of particles around the screen. Secondly, the rigid, welded construction of heavy-gauge brass makes sure the fit will remain tight, even when trapped sediment builds up pressure.

Third, you'll see that the new AT is easy to clean. No sharp edges or weave crevices in the screen for particles to cling to. Blow-down cleaning is simplified by the 45° angle construction.

Write for Sarco Bulletin No. 1210B which gives dimensions, capacities, and technical data. 7317-B

NOTE THIS ADDED PROTECTION AND CONVENIENCE

1. Bodies of heavy-duty 250 psi semi-steel. Tensile strength to 30,000 # per square inch minimum.
2. For maximum strength, bodies are reinforced with external rib.
3. Long, tapered screen seat assures correct screen position and tight fit without buckling.
4. Cap design provides a sediment collection chamber below screen.
5. Generous proportion of open screen area in relation to pipe size minimizes pressure drop.

SARCO
COMPANY, INC.
635 Madison Avenue, New York 22, N. Y.

STRAINERS • STEAM TRAPS • TEMPERATURE CONTROLLERS • HEATING SPECIALTIES

RELIABLE RAY BURNERS *FIRST* IN *ECONOMY SALES PERFORMANCE*

When you specify Ray Burners, you get lowest initial cost, economical operation and proven performance. Ray is the pioneer in burners, setting industry standards for quality. This leadership, combined with world wide acceptance, local service and mass production economies makes Ray Burners the most efficient, practical units you can specify. Write for engineering data.

When you need copper tube fittings look for the Anaconda orange and black carton

COMPLETE RANGE OF TYPES AND SIZES

Brass Fittings for Flared Tubes. In all standard combinations, nominal sizes from 1/8" through 3"

Wrought-Copper Solder-Joint Fittings. Nominal sizes 1/8" through 4"

Flanged Fittings. In sizes to meet all standard requirements

Accessories. Hangers, Flanging and Sizing Tools, Tube Straps

Cast-Brass Valves. Full range of standard sizes and combinations

Cast-Brass Solder-Joint Fittings. Nominal sizes from 1/8" through 12"

Wrought-Copper Solder-Joint Fittings for Refrigeration and Air Conditioning use. Actual OD sizes 3/16" through 4 1/8"

Cast-Brass Solder-Joint Drainage Fittings. In all standard combinations from 1 1/4" through 8"

Designed for your convenience, the new Anaconda carton serves as a handy container on the job, in your truck or in the stock room. Contents are clearly indicated so you can quickly spot the fittings needed.

These new cartons are being placed in the hands of Anaconda distributors as quickly as possible, but whether in the new package or not, Anaconda Fittings are the best you can buy. On your next copper job, use products that you can depend on—use Anaconda Copper Tubes and Anaconda Fittings.

HAVE YOU OUR CATALOG, "Anaconda Copper Tube Fittings and Valves"? If not, write for a copy today. It lists, with illustrations and roughing-in dimensions, the complete range of Anaconda Fittings in sizes from 3/16" through 12" for all copper tube applications—general plumbing, heating, air conditioning and refrigeration. Ask for Anaconda Publication C-12. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario, Canada. 5806

ANACONDA®

COPPER TUBE AND FITTINGS

Products of The American Brass Company

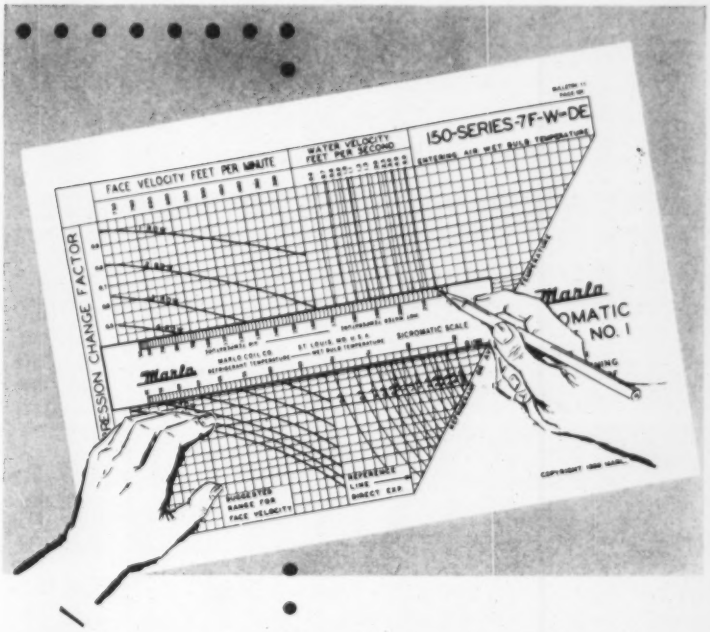
AVAILABLE THROUGH PLUMBING WHOLESALERS

Now... Save Time... Save Money
ON COIL SELECTION

with *Marlo* sicromatic charts and rule...

for the Architect and Engineer

- No More Trial-and-Error Calculations
- No Interpolations



A QUICK, ACCURATE WAY TO DETERMINE NUMBER OF TUBE ROWS • REFRIGERANT TEMPERATURE • LEAVING AIR TEMPERATURE

When selecting coils, there's no need to waste time on long mathematical equations and trial-and-error calculations with pages and pages of tables. These handy charts and rule from Marlo permit direct graphical coil selection *in a matter of seconds*, with the simple location of two straight lines. On one chart, you can read all necessary data for a particular application, including proper refrigerant or chilled water temperatures.

FREE Revised Bulletin on
MARLO COOLING COILS
Complete with information on design, construction, dimensions, performance characteristics, etc.

Send Coupon Today

Marlo Coil Co.
7100 S. Grand Blvd.
St. Louis 11, Mo.

Please send me your sicromatic charts and rule, and copy of your new revised cooling coil bulletin 11.

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COMPANY_____

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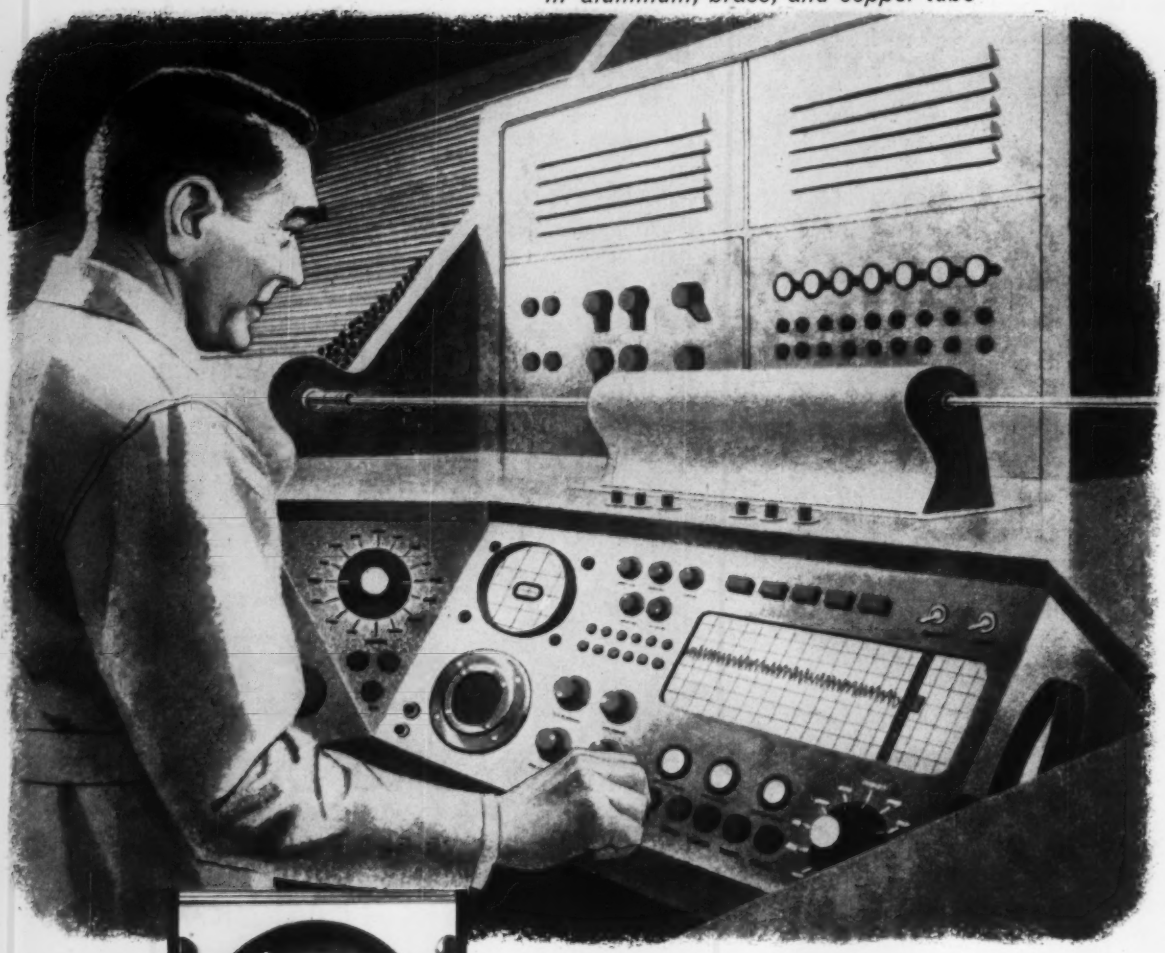
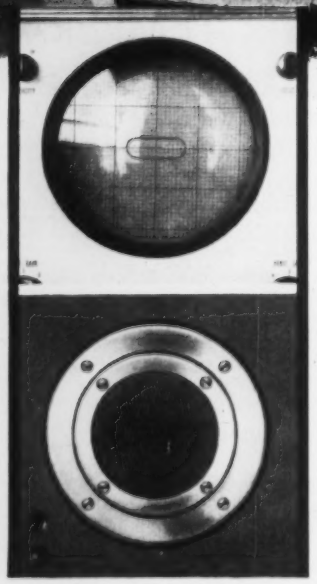
CITY_____ ZONE____ STATE_____

Marlo
coil co.
SAINT LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment since 1925

the meaning of custom-made quality
in aluminum, brass, and copper tube





One "peep" on the United electronic scope signals the slightest flaw or variance within specifications.

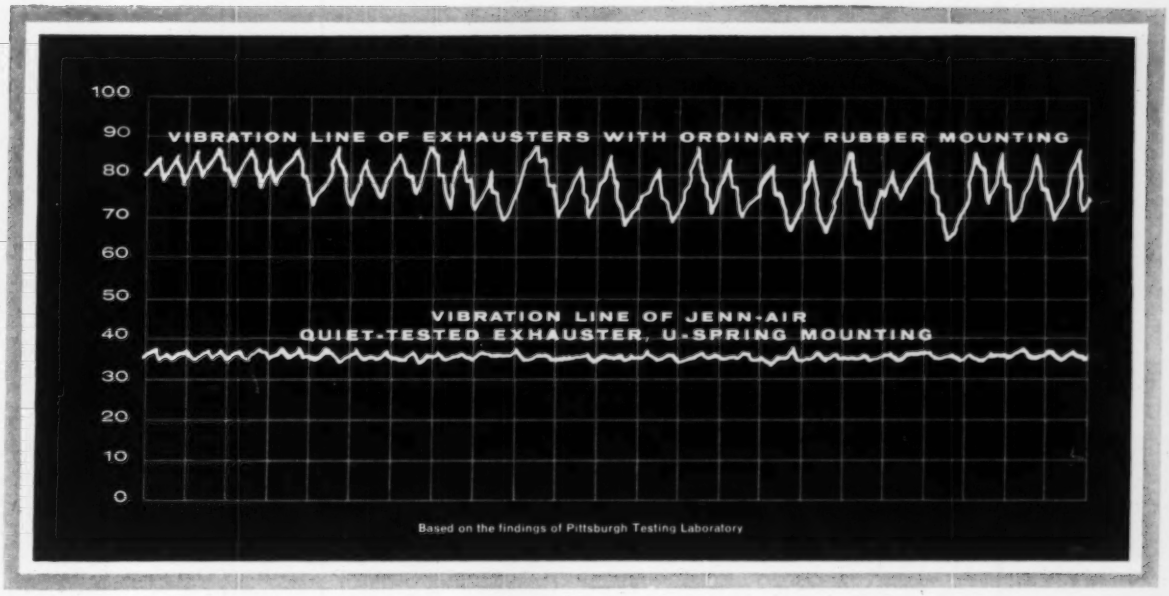
As a safeguard, any deviation is noted by an audible "beep". United Eddy Current testing automatically rejects inferior tube.

At United . . . the "BEEP" and the "PEEP" of Electrical Eddy Currents lavish special care on your tube order

Eddy Current electronic testing — with equipment developed by United engineers — detects those flaws in seamless tubes which are invisible. Another reason why for the highest quality in thin wall or standard aluminum, brass, and copper tubing, always specify United. For details, samples, and fast shipment, write, wire or phone;

UNITED WIRE AND SUPPLY CORPORATION
1497 Elmwood Avenue, Providence 7, Rhode Island.

Specify **UNITED** *for aluminum, brass, copper tube and wire...brazing alloys*



The above chart shows a comparison of vibration levels between ordinary exhausters and Jenn-Air Quiet-Tested Exhausters.

44% Less Vibration with JENN-AIR Quiet-tested Roof Exhausters!

Independent Laboratory Tests Prove Conclusively That Jenn-Air Quiet-Tested Roof Exhausters With U-Spring Suspension Show 44% Better Vibration Isolation Than Exhausters With Power Assembly Mounted in Rubber

Noise elimination is a problem which faces the ventilation industry today. To minimize the noise caused by vibration, Jenn-Air developed the Quiet-Tested Roof Exhauster with U-Spring cushion suspension. Now an independent laboratory offers proof positive this new principle of suspending the power assembly with U-Springs does the job. The PITTSBURGH TESTING LABORATORY, an independent research firm, was recently asked to compare Jenn-Air's Quiet-Tested Roof Exhauster, with U-Spring Suspension Mounting, against exhausters with ordinary rubber isolators. Tests were conducted under actual working conditions. Result: (see chart for dramatic evidence): *Jenn-Air Exhausters showed 44% less vibration transmission than the other exhausters.*

U-SPRING CUSHION SUSPENSION MOUNTING REDUCES VIBRATION . . . NOISE LEVEL

This innovation is another important improvement by Jenn-Air. It ensures against the major operating vibration and noise being transmitted through the duct work and into the building. The stainless steel also assures you the permanency of this quiet operation. Jenn-Air—and only Jenn-Air—Quiet-Tested Exhausters are proved under simulated field conditions. Each unit must pass rigid inspection by the critical *Vibronic Eye* . . . is 'screened' in Jenn-Air's Sound-Elec Test Chamber to detect noise and vibration.

Patents Pending

JENN-AIR PRODUCTS COMPANY, INC.
1102 Stadium Drive • Indianapolis, Indiana

Jenn-Air Quiet-Tested Roof Exhauster, with U-Spring Cushion Suspension Mounting. Note low contour design which complements modern architectural lines.

JENN-AIR PRODUCTS COMPANY, INC.
1102 Stadium Drive
Indianapolis 7, Indiana ● HPAC

Gentlemen:
Please send me free catalog giving complete information on how Jenn-Air U-Spring Cushion Suspension Mounting cuts vibration, lowers noise level.

Name_____
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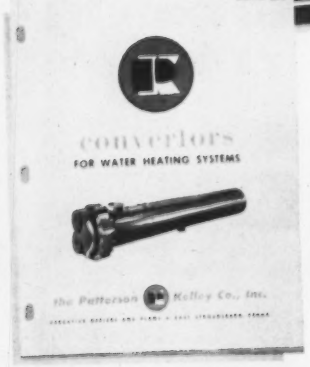
In Bulletin No. 6050 on P-K forced boiler water heat exchangers complete capacity tables are provided, grouped by temperature ranges. Pressure drop is shown for each capacity. Dimensional data supplied

Catalog No. 19 covers P-K storage water heaters in plain steel, copper-lined, copper silicon, Pre-Krete lined, clad and galvanized. In addition to tabular data on capacities, weight and dimensions, this book carries a handy conversion table to determine capacities of heating sections with various temperature ranges and steam pressures.

Catalog No. 202 describes P-K instantaneous water heaters. Contains capacity tables covering two, four and six pass design. Tables are grouped by steam pressures ranging from 0 to 100 psi. Inlet and outlet temperatures are listed with hot water capacities.



In this P-K Bulletin No. 303-A, covering convertors for forced circulation water heating systems, capacity tables include the usual ranges for standard water heating systems. Also included are general ranges for radiant heating systems.

FOUR P-K CATALOGS YOU NEED

when specifying any hot water system...

AND HOW TO GET YOUR COPIES

With these four P-K catalogs on your desk you have installation and performance data, conveniently tabulated on instantaneous hot water heaters, storage water heaters, convertors for water heating systems and forced boiler water heat exchangers. Just write us for P-K heating equipment file #126 and we'll send you the set. The Patterson-Kelley Co., Inc., 2112 Warren Street, East Stroudsburg, Pa.

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Water Heater Division

storage water heaters • instantaneous heaters • convertors • water to water exchangers

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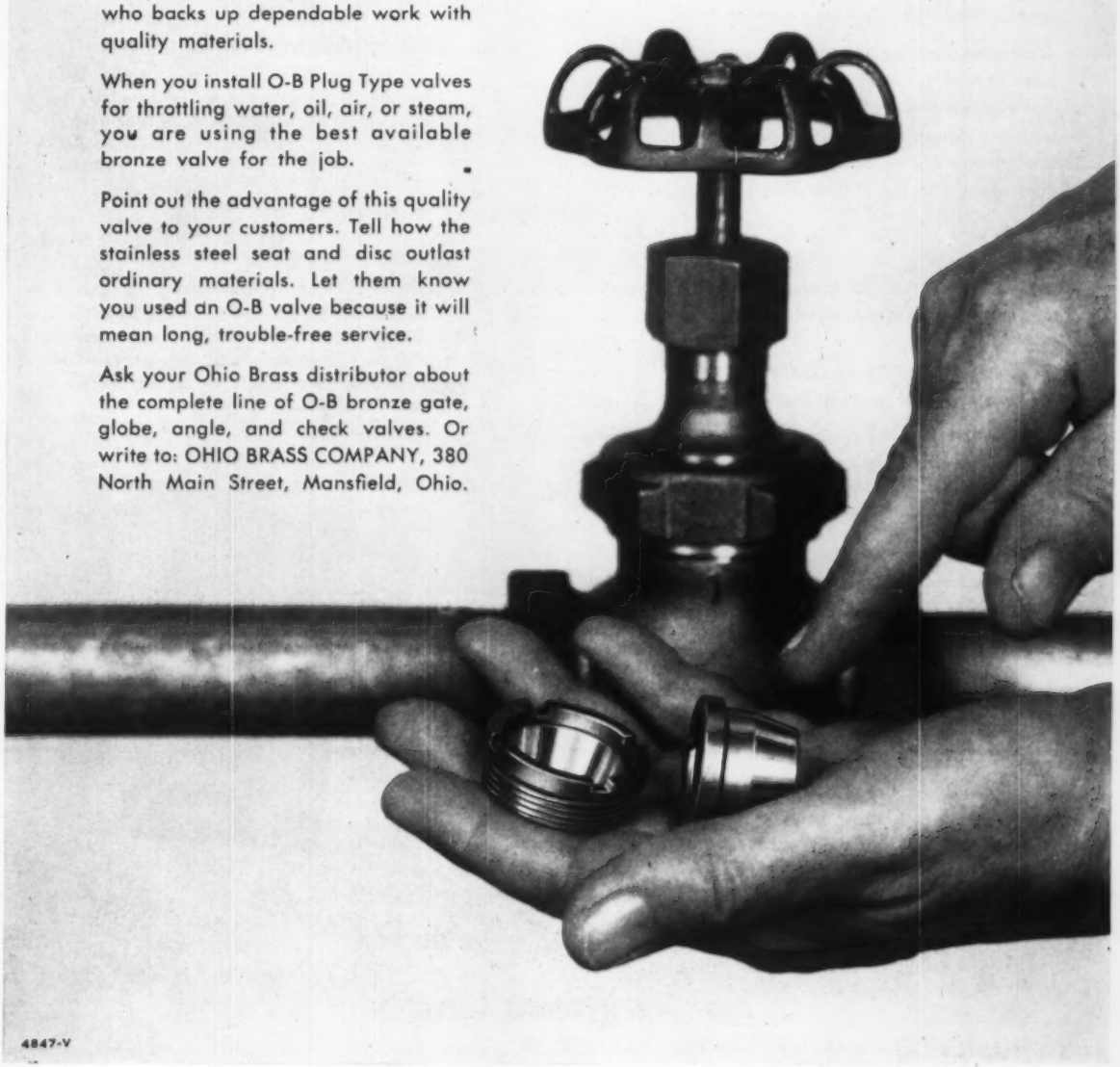
The contractor who will stay ahead of today's tough competition is the one who backs up dependable work with quality materials.

When you install O-B Plug Type valves for throttling water, oil, air, or steam, you are using the best available bronze valve for the job.

Point out the advantage of this quality valve to your customers. Tell how the stainless steel seat and disc outlast ordinary materials. Let them know you used an O-B valve because it will mean long, trouble-free service.

Ask your Ohio Brass distributor about the complete line of O-B bronze gate, globe, angle, and check valves. Or write to: OHIO BRASS COMPANY, 380 North Main Street, Mansfield, Ohio.



4847-V

Announcing a new book of utmost value to Designers and Users of Atmospheric Heat Exchange Equipment

"EVALUATED WEATHER DATA FOR COOLING EQUIPMENT DESIGN"

This book is an evaluated summary of 10 million summer hourly observations spanning 10 years at over 400 official United States, Canadian, and Mexican weather stations.

Staff-prepared by recognized authorities, it presents in text, table and map form the 1%, 5% and 15% design levels of wet bulb temperatures at each weather station. Other values presented include dry bulb temperatures, and wind speeds and directions coincident with the high wet bulb temperatures.

"Evaluated Weather Data for Cooling Equipment Design" is the most complete and up-to-date weather data manual ever presented to designers and users of atmospheric heat exchange equipment.

Typical of Data Presented in Chapter and Section Form—

TEMPERATURE VARIATIONS:

Daily variations; Monthly variations of wet bulb temperatures; Annual climatic ranges of wet bulb temperatures; Typical "hot spell" weather sequences.

WET BULB DESIGN VALUES:

Pertinent considerations; Wet bulb temperature tabulations at 3 design levels; Iso-line maps of wet bulb temperature frequency (1%, 5% and 15% design levels); Temperature differences associated with various frequency levels.

COINCIDENT DRY BULB VALUES WITH HIGH WET BULB VALUES:

Tabulation procedure; Coincident patterns on psychrometric charts (49 cities).

WINDS RELATED TO HIGH WET BULB TEMPERATURES:

Velocity changes with height above ground; Daily changes in wind; Upslope and downslope winds; Sea and lake breezes; Winds coincident with high wet bulb temperatures; Determinations of predominant directions; Ranges of velocity; Cooling tower orientation.

DRY BULB DESIGN VALUES:

Frequency of occurrence; Estimating frequency points.

INTERPOLATION BETWEEN STATIONS:

Variation in wet bulb due to elevation; Variation in dry bulb due to elevation; Variation in atmospheric pressure; Air mass modification; Influence of terrain and adjacent operations; Solar radiation; Influence of vegetation; Examples.

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Copies of "Evaluated Weather Data for Heat Transfer Design" will be available beginning December 1, 1958, through the Fluor Representative in your area. Or, write direct to Fluor Products Company, Department DEW, Whittier, California.

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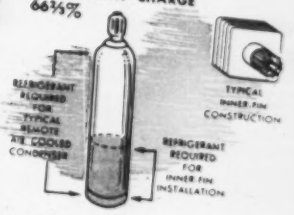
What's NEW in Remote Air Cooled Condensers? *This*

A REMOTE AIR COOLED CONDENSER THAT REQUIRES UP TO 1/3 OF THE REFRIGERANT CHARGE USED BY COMPETITIVE MODELS

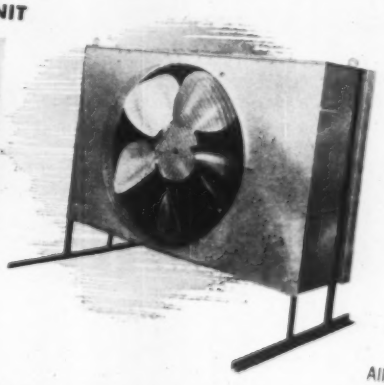

AVERAGE SAVING ON REFRIGERANT CHARGE
66⅔%
REFRIGERANT REQUIRED FOR TYPICAL REMOTE AIR COOLED CONDENSER
TYPICAL INNER-FIN CONSTRUCTION
REFRIGERANT REQUIRED FOR INNER-FIN INSTALLATION

A RECENT 300 TON JOB SHOWED SAVINGS OF 1800 LBS. OF REFRIGERANT THROUGH USE OF THESE UNITS.

Yes, the Dunham-Bush 'BC' Remote Air Cooled Condensers with famous Inner-Fin construction mean savings of 67% in refrigerant charge. Additionally, they mean smaller receivers and minimum loss if the system charge is lost. In these expertly planned units, the exclusive Inner-Fin construction diminishes the internal volume of the coil while increasing the heat transfer coefficient. And higher heat transfer factors permit design of more compact units, saving valuable space in installation.

AS MUCH AS 53.5 TON CAPACITY IN ONE UNIT

The Dunham-Bush line of 'BC' Remote Air Cooled Condensers includes models in 13 sizes with capacities ranging from 2.2 tons to 53.5 tons, making possible use of a single unit for practically any job !



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FINISH—hard grey, all weather resistant plastic vinyl.

All interior surfaces of the unit casing are given an extra finish coat of plastic vinyl.

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at all ambients, Dunham-Bush engineers offer the 'PS' Pressure Stabilizer.

'PS' units can be mounted indoors near the compressor, facilitating the making of necessary adjustments. They are thoroughly factory tested and assembled, and require connection only to the refrigerant liquid and discharge lines. No extra piping or special loops required. Regulating valve gives smooth pressure control and eliminates wide pressure fluctuations inherent in other head control systems.

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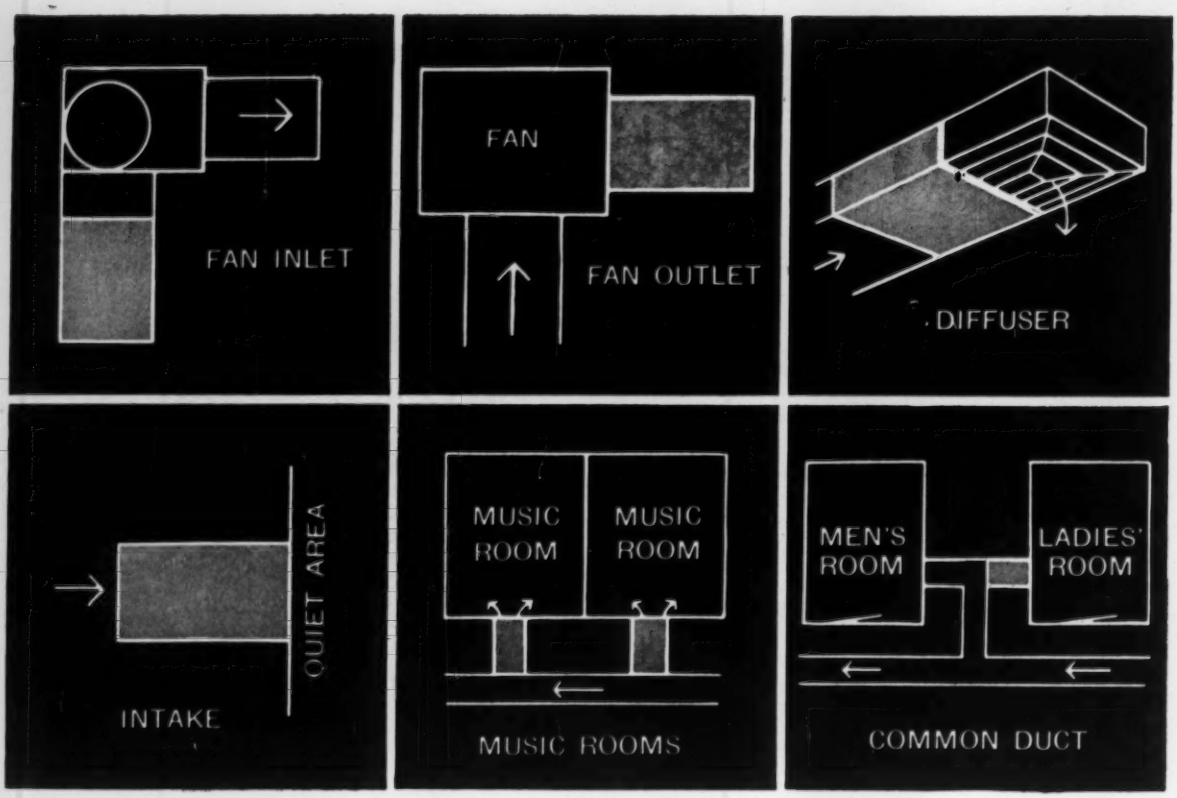
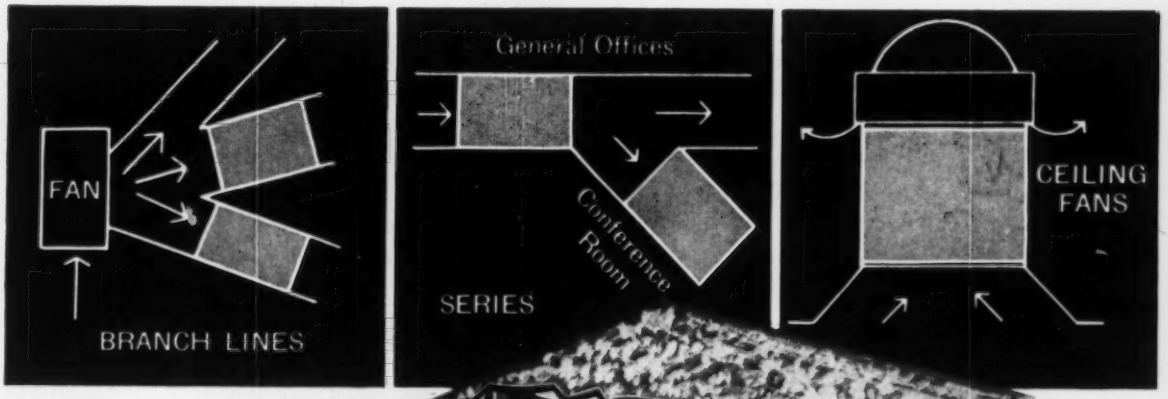


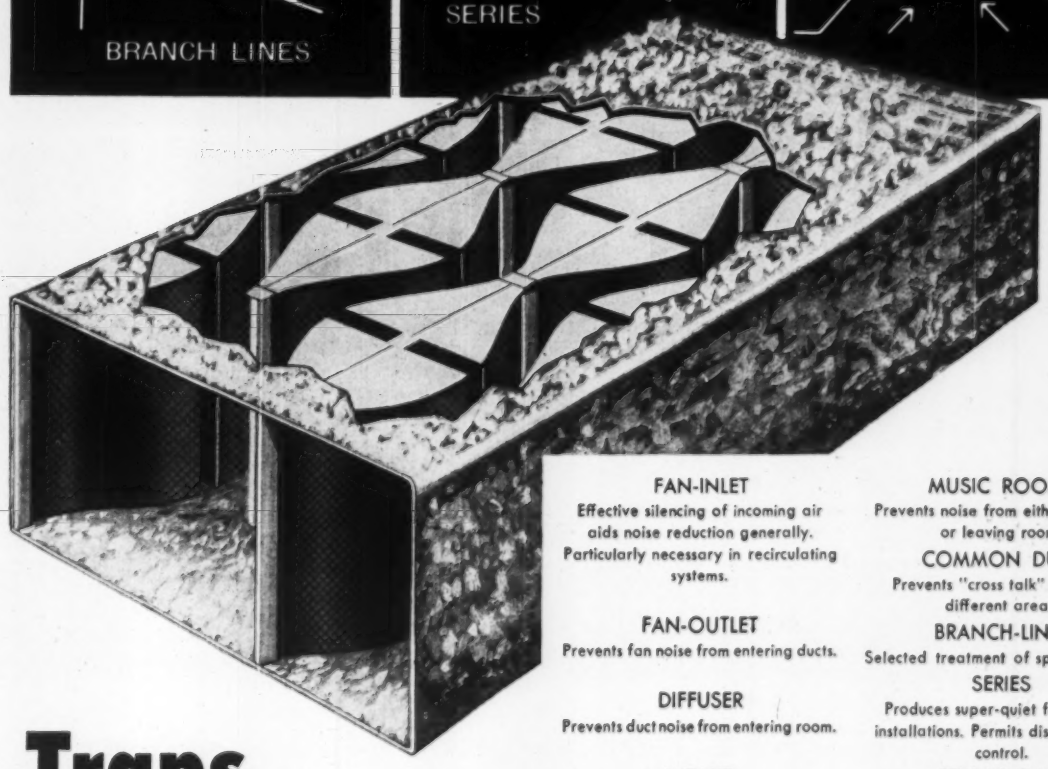
Every Building Needs Aircoustat® Sound

AIRCOUSTAT silences noises of all frequencies

Eliminate disturbance, distraction and irritation caused by noises escaping from one area to another through ductwork.

Install AIRCOUSTAT Sound Traps. AIRCOUSTAT eliminates guesswork, wasted space and unnecessary expense of duct lining. You can guarantee your client trouble-free performance. You can estimate with complete confidence the performance of particular applications. If AIRCOUSTAT fits geometrically, it fits acoustically.





Traps

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Effective silencing of incoming air aids noise reduction generally. Particularly necessary in recirculating systems.

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Prevents fan noise from entering ducts.

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Prevents duct noise from entering room.

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Prevents outside noise from entering quiet area.

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Prevents noise from either entering or leaving room.

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Prevents "cross talk" between different areas.

BRANCH-LINES
Selected treatment of special areas.

SERIES
Produces super-quiet for special installations. Permits discriminating control.

CEILING FANS
Prevents fan and exhaust noise from disturbing particular areas.

traveling from one area to another through ductwork

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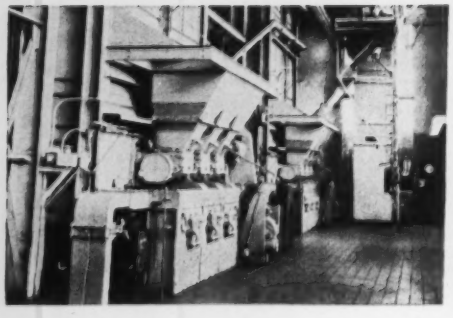
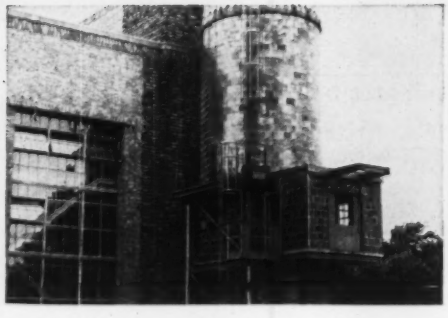
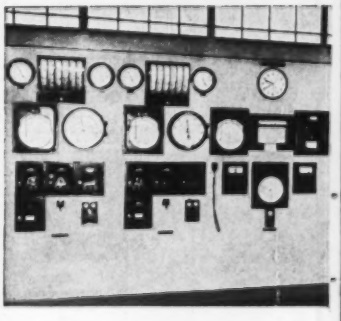


Firing aisle shows both Union Iron Works boilers . . . identical 2-drum, bent-tube type with a normal rating of 70,000 lb/hr. These units are fired by Detroit Rotograte Spreader Stokers.



Furnace ash and dust from Prat-Daniel Collectors are conveyed pneumatically to this 50-ton ash storage silo. Rotary dustless unloader assures a clean operation. Ash handling system is by United Conveyor Corp.



Combustion controls and instruments — centered in this control panel by Hays Corporation — regulate combustion and auxiliary operations automatically.

Coal scores with Notre Dame

University power plant burns coal for modern steam generation

Enrollment growth and building expansion had put a strain on the power plant at the University of Notre Dame, South Bend, Ind. After careful study—by the consulting firm of Albert Kahn Associated Architects and Engineers, of Detroit—a decision was made to modernize steam facilities and add power generating equipment. Two new coal-fired boilers, a turbo-generator and auxiliary equipment were installed.

Maximum efficiency is achieved through automatic combustion control and complete instrumentation. Today steam is generated *economically.* Another noteworthy result of these innovations has been the *cleanliness* of operation . . . making Notre Dame's power plant a model of good housekeeping.

Coal is lowest-cost fuel

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest-cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% *more* steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

Technical advisory service

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

BITUMINOUS COAL INSTITUTE

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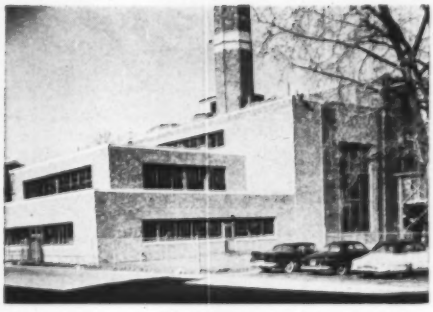

Exterior view of Notre Dame power plant. Careful planning of design combines spacious interior and pleasing exterior lines to maintain campus beauty.

SEND COUPON FOR NEW "Guide Specifications for Underfeed Stoker Fired Low-Pressure Heating Plants." Heavy demand for the first edition of this booklet, adaptable for design loads 3,000 to 26,000 EDR steam, has justified an expanded edition covering application of underfeed stokers to firetube, watertube and sectional cast iron boilers. Complete specifications criteria cover all aspects of typical heating plant.

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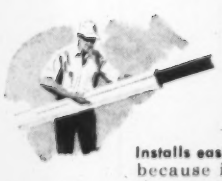
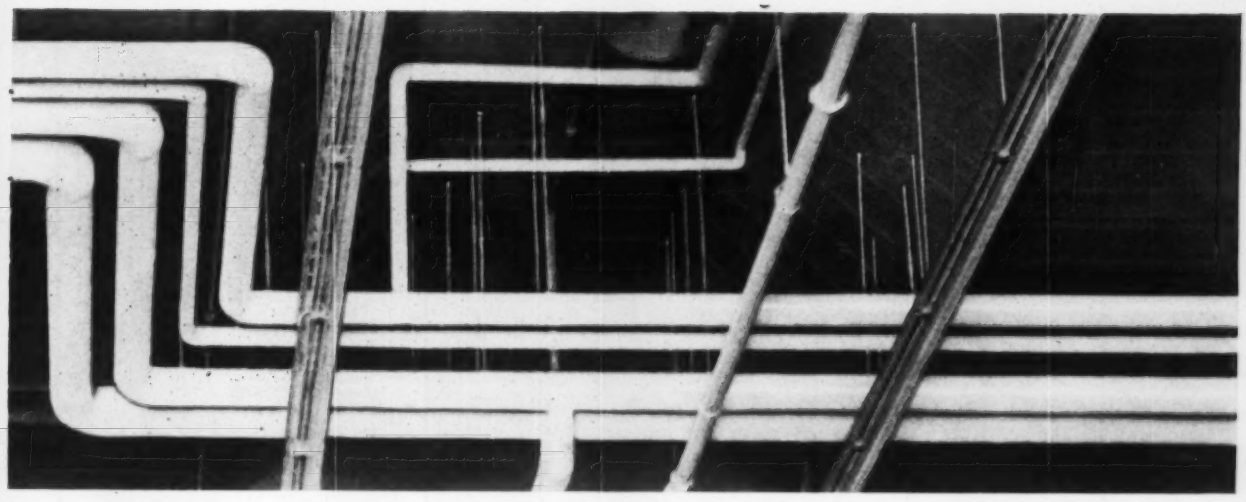


Installs easier, faster . . . because its size and shape never vary. Butt straps go on easier, too.



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2 new types of white jacketing

Easier to install · More attractive · Thermally effective · Priced low for substantial savings

TEST IMPROVED new Fibrocel®—even on just a short run of pipe—and see the difference! See why this rigid, molded insulation makes an installation so many ways better!

First thing you notice about Fibrocel is that it's molded. For only an unvarying metal mold can produce such nearly perfect roundness, such uniformity of size and shape. The result—less time needed to get the neater, better fitting job you want . . . with the pipeline always dead centered in the insulation for top insulating value.

Rigidity is another Fibrocel advantage. Working with a rigid material, butt straps go on easier, faster. And your inspection (whether one day or one year after installation) reveals not a sign of denting, bulging or "fish mouthing"—so common with soft insulations.

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Fibrocel now comes in virtually any jacket you'll ever need. *New Type VS* is richly creped, pure white kraft backed by 1/3-mil foil. One painting provides complete coverage. Yet it's priced as low as canvas. Then, there's new *Type VB*. Priced slightly higher—but well worth it! Outer surface has same rich creping as Type VS, inner vapor barrier is full mil thickness of aluminum foil, pipe facing is creped black kraft. Creping permits surfaces to "move" with foil as moisture conditions vary. Fibrocel is also available with "Type C" canvas finish.

Let us send you a copy of IN-155A, the informative 8-page Fibrocel folder. Write for it today. Address Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

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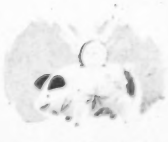

Costs less. Don't let Fibrocel's appearance and efficiency mislead you. It's priced low!

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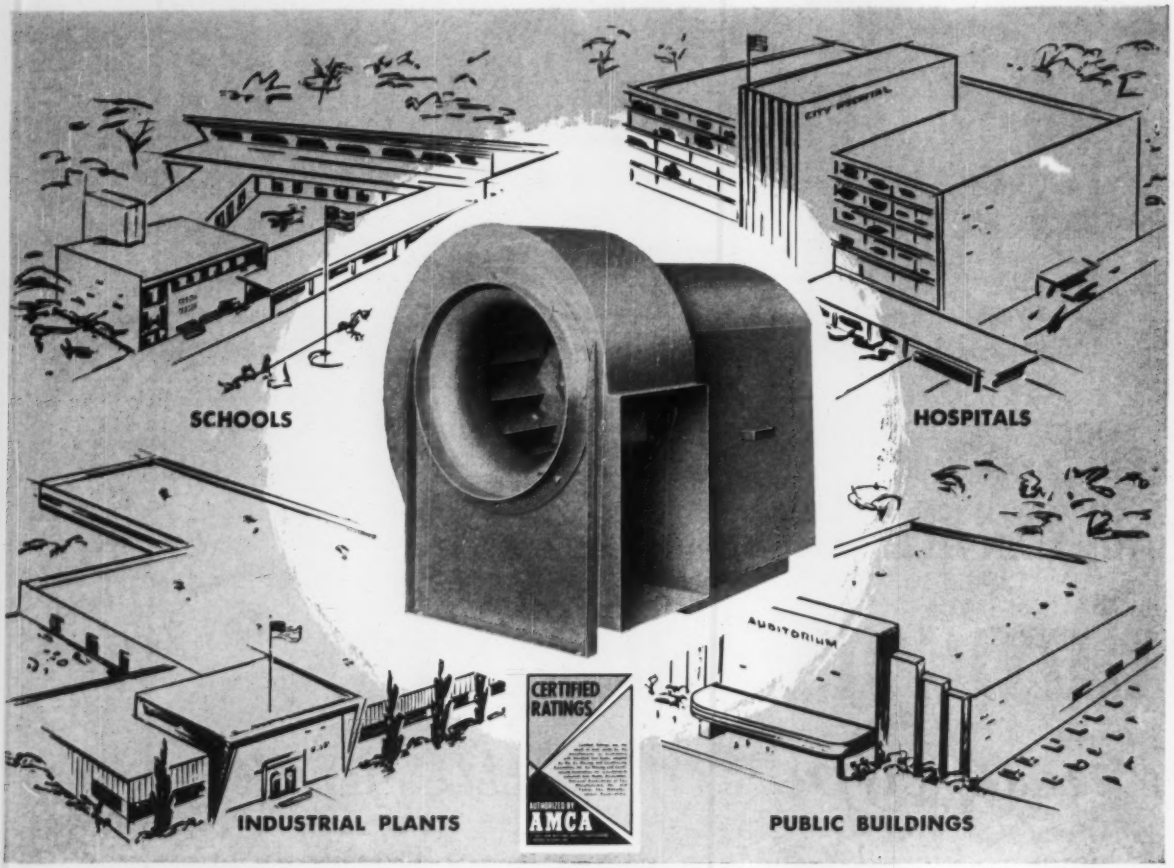

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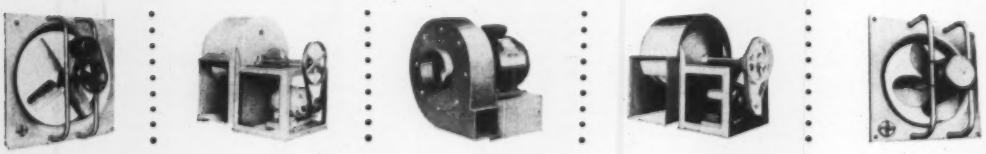

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In "Genetron" Super-Dry Refrigerants, moisture has been reduced almost to the vanishing point. "Genetron" 12, for example, has less than one-thousandth of one per cent of moisture! And the tight quality "specs" for "Genetrons" are usually *bettered* in production. "Genetron" Super-Dry Refrigerants are available from wholesalers everywhere. So be sure to make your next order—"*Genetron.*"

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- Guaranteed exceptionally low moisture content.
- Noncorrosive to standard equipment materials, nontoxic, nonflammable, stable, safe.
- Critical and freezing points well outside range of operating uses.
- Solvent action on oil helps prevent solidification or congealing of lubricant; aids in lubrication of equipment; generally miscible with oil.
- Freely interchangeable and may be mixed in any proportions with comparable fluorinated hydrocarbons meeting the same strict refrigerant specifications.
- Available everywhere, from refrigeration wholesalers throughout the country.

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Trichloromonofluoromethane

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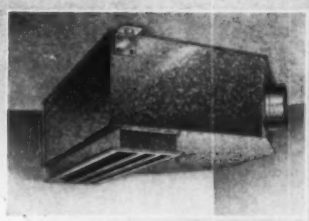
in six sizes
80-1500 cfm air delivery

LINEAR DIFFUSER MODEL
in three sizes
80-450 cfm air delivery



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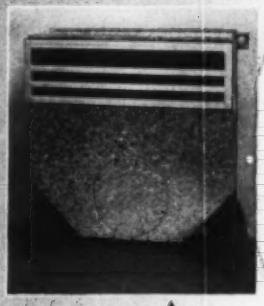
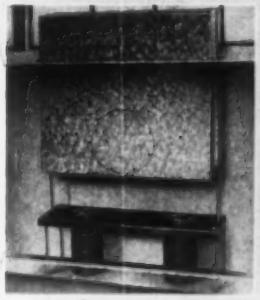
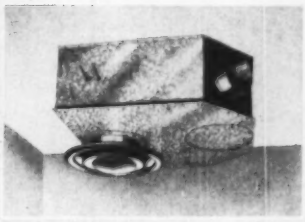


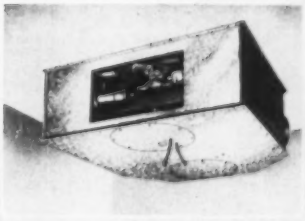
UNDER-WINDOW MODEL
in three sizes
80-450 cfm air delivery



REMOVABLE UNDER-WINDOW MODEL
in three sizes
80-450 cfm air delivery



DIFFUSER MODEL
in six sizes
80-1500 cfm air delivery



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in six sizes
80-1500 cfm air delivery
Rectangular and Multiple Round Outlets

NOW! ALL SIX MODELS offer greatest design flexibility for single and dual duct systems

All six high performance, space-saving, cost-saving models are available with Constant Volume Control . . . with either flat plate or sinuous baffle . . . with static pressure taps for quick accurate air delivery measurement . . . and with the patented helical spring damper that assures complete close-off.

Wherever your plans call for a high velocity air conditioning system—whether you're designing a new structure or remodeling an old one—choose Connor high velocity valve attenuators . . . there's a model that meets every design and performance test.

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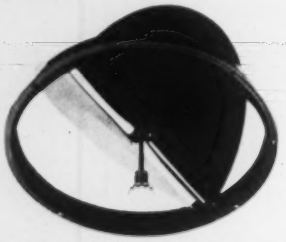

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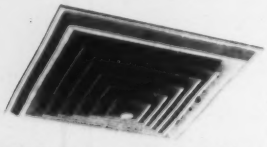

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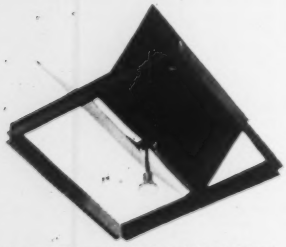

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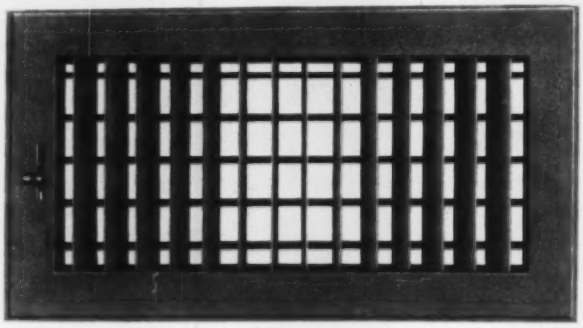

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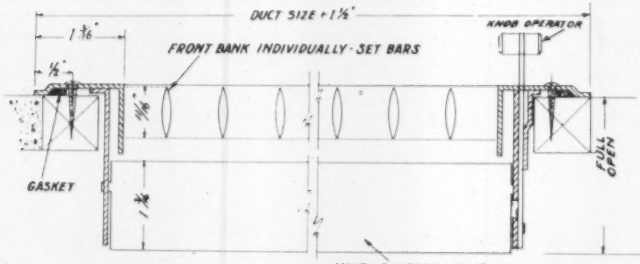

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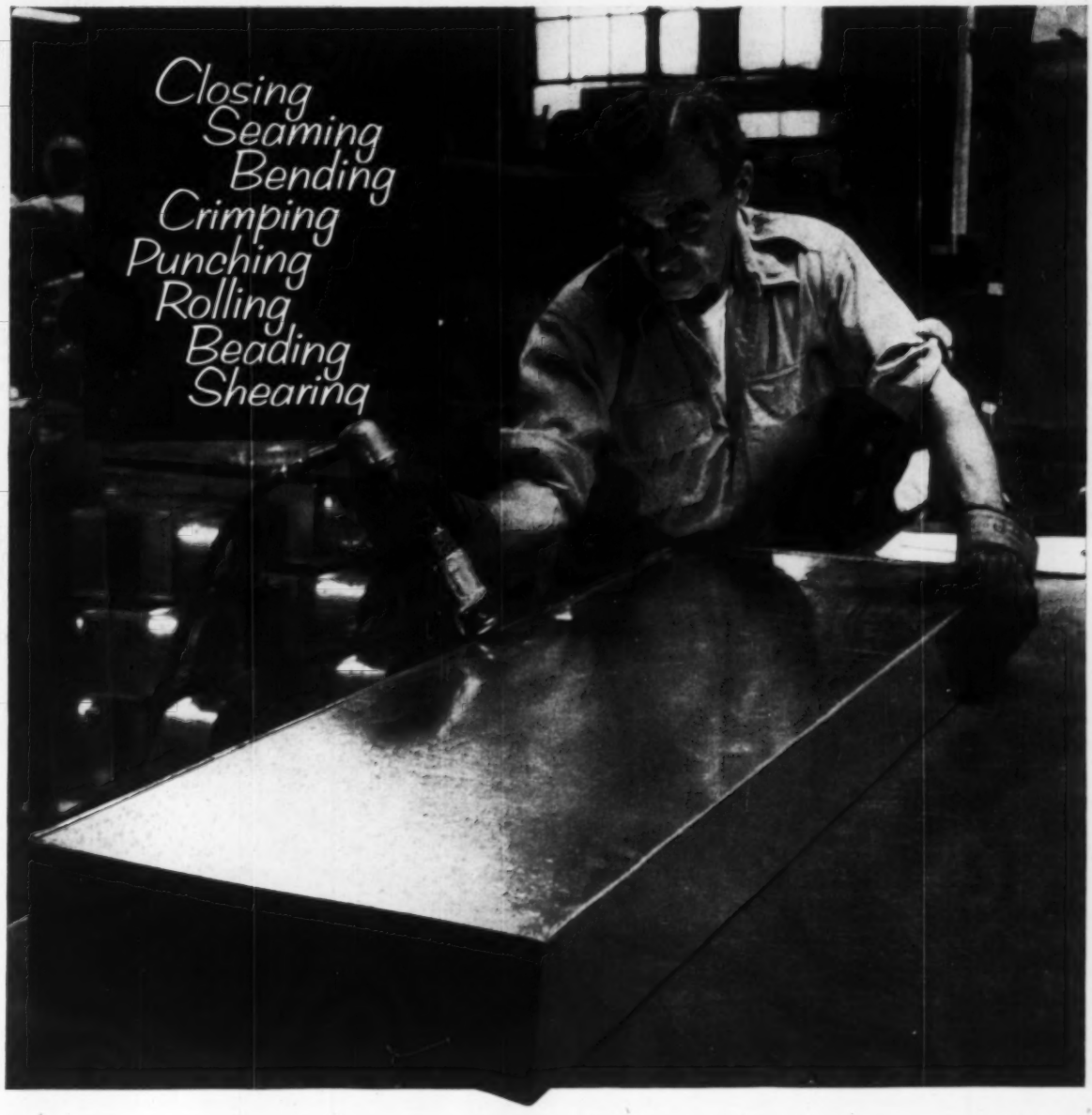

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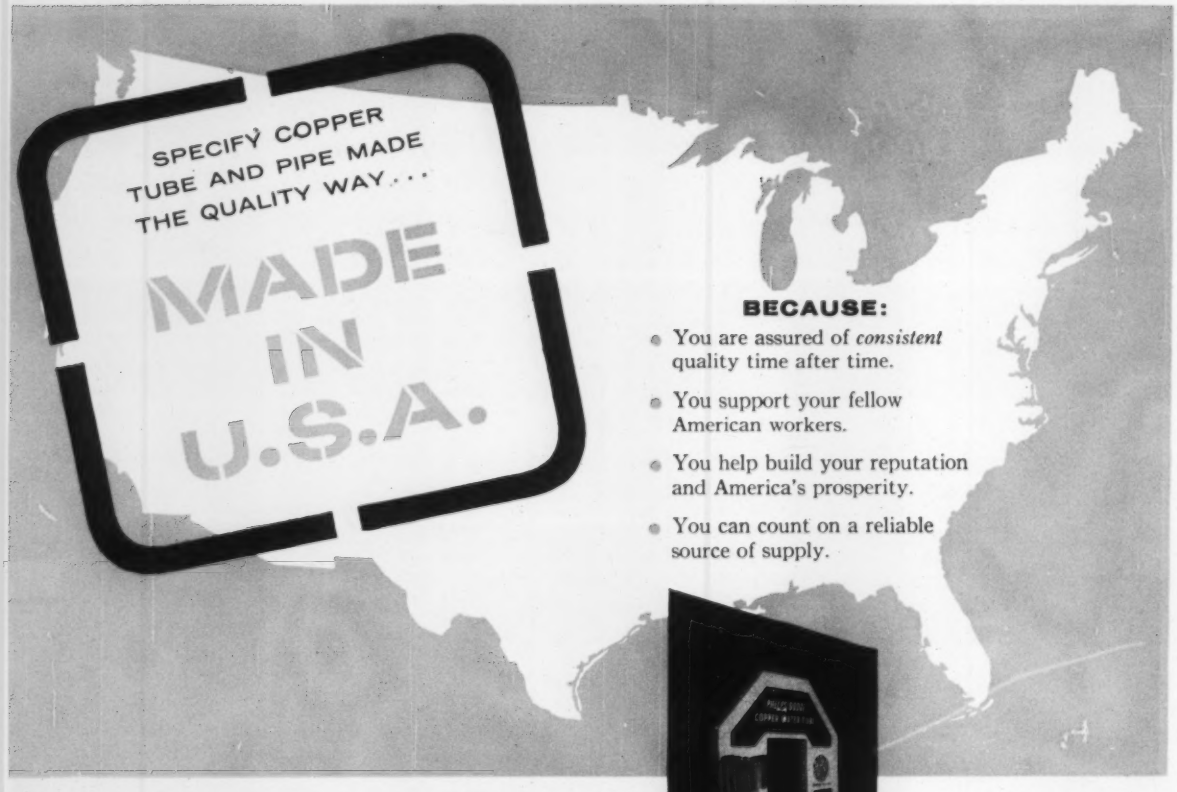

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NEXT MONTH's issue will be a banner one, featuring —in addition to its regular editorial content—two big reasons for you to keep it handy throughout next year. One is the annual Directory Section which will contain an up-to-date alphabetical listing of all products in the field and their manufacturers. The second is a complete Show Section previewing the 14th International Heating and Air Conditioning Exposition in January—telling who will display there, what products they will show. There is a third reason, too: a new HPAC Engineering Data File presenting a comprehensive report on what to consider when selecting valves for process and power piping applications.

1959 Construction To Set New Record

. . . for work put in place

CONSTRUCTION in 1959 will set new records, both in contracts awarded and in work put in place, according to F. W. Dodge Corp.

Contracts in 1959 for all types of construction will total $35.6 billion, a 3 percent increase over this year's estimated $34.7 billion, according to the Dodge figures.

The principal upward push in construction contracts next year is expected to be in private projects, in contrast to this year, where government owned construction sparked the recovery from the recession.

The largest percentage increase, 14 percent, is expected to come in contracts for new factory buildings (as measured in floor area). The report notes, however, that "this would still represent a recovery to a modest total. If better business should cause managements to revise upward their plans and appropriations for plant and equipment above the levels they presently indicate, this figure could go substantially higher."

Contracts for nonresidential buildings are estimated at $11.6 billion in 1959, up 5 percent from 1958. In terms of physical volume, floor area is expected to increase by 4 percent over this year, with the larger individual categories as follows: manufacturing, up 14 percent; hospitals, up 5 percent; religious buildings, up 4 percent; commercial buildings, up 3 percent; schools, up 2 percent; social and recreational buildings, down 5 percent; public buildings, down 9 percent.

Heavy engineering contracts in 1959 are estimated at $9.7 billion, up 2 percent from 1958.

Total public and private housing starts this year are estimated at 1,160,000, and no change is indicated in this figure for 1959. The report notes the adverse influence of rising interest rates on VA and FHA programs, and the possibility of offsetting actions by Congress and the Administration in 1959. Because of rising costs, dollar volume of residential contracts is estimated at 1 percent above the 1958 level, but in view of a trend toward smaller units, including apartments, physical volume as measured in floor area is expected to decline by 2 percent. Dollar volume of residential contracts in 1959 is estimated at $14.3 billion.

Noting that the estimate of a 3 percent increase in total contracts next year may seem modest in view of the prospect of a much better business climate in 1959, the report says "it must be remembered that we are talking in terms of contracts, and that a sharp rise in contracts has already occurred in 1958. In considerable degree, the increases this year represent specific government efforts to stimulate the economy by stimulating construction . . . There has been some 'borrowing from the future.'

"If our expectations are realized," the report concludes, "construction contracts next year will again set a new record in dollar volume, and 1959 will mark the 15th consecutive increase and the 12th consecutive record year."

Contracts for future construction for this past September totaled $3,215,919,000, an increase of 26 percent above the like month of 1957. The increase was the greatest over a corresponding month of 1957 that has been reported so far this year.

The cumulative totals of contracts for the first nine months of 1958 amounted to $26,985,813,000, up 7 percent over the like 1957 period. The breakdown by major construction categories shows: nonresidential, at $8,504,854,000, down 3 percent; residential, at $10,945,492,000, up 7 percent; and heavy engineering, at $7,535,467,000, up 21 percent. ≠

Ultraviolet-Sensing Tube Detects Fire, Vapors

. . . predict wide application

SCIENTISTS at Minneapolis-Honeywell Regulator Co. have achieved a breakthrough in basic research in finding a way to make practical use of ultraviolet rays to detect fire and explosive vapors.

An ultraviolet-sensitive tube, developed after five years' work at the company's research center, can simultaneously detect fire, smoke, and combustible vapors. It is said to be the first device ever designed that can sense all three of these phenomena at the same time.

Finn J. Larsen, Honeywell research director, predicts that the new tube—about the size of an index finger—will have wide application in fire

and explosion warning systems, making warning devices that are very accurate and versatile.

In a typical warning system, Dr. Larsen says, the tube would work with an amplifier circuit to add up the impulses of electrical energy generated by the tube as it counts ultraviolet rays. Whenever the rate of these impulses exceeded a specific rate an alarm would be sounded, equipment turned off, sprinklers started, etc.

Dr. Larsen states that the new tube has an almost unlimited life expectancy and also can be mass-produced economically. ∓

Launch Certification For Unitary Conditioners

. . . under ARI-NWAHACA Co-op

COMPLETION of the first phase of the certification program for unitary air conditioners, initiated last May as a cooperative project of the Air-Conditioning and Refrigeration Institute and the National Warm Air Heating and Air Conditioning Association, has been announced by Geo. S. Jones, Jr. and George Boeddener, managing directors of ARI and NWAHACA, respectively.

This initial phase included the signing of contract agreements by the majority of manufacturers in this field, and was highly successful, according to spokesmen for the cooperating associations.

The program, which becomes effective January 1, will cover self-contained air conditioners such as those used in commercial applications, central residential units and other air conditioning combinations designed as units, as differentiated from room coolers on the one hand, and large, field assembled system installations on the other. Certification of this equipment by its manufacturers will include a program of testing by an independent laboratory under contract to ARI, which will administer the program.

The unitary certification program is based on compliance with all provisions of ARI Standard 210-58, and provides that cooling capacity ratings of unitary equipment be expressed in Btu per hour or tons, but not in horsepower of compressor motors, which it is felt is not a true measure.

Already firms representing the major producing capacity in unitary air conditioners have entered into contract agreements with ARI, and a number of others are expected to sign in the near future. Under this agreement, manufacturers certify to ARI by submitting data, and certify to the public by display of a certification seal that their products are in compliance with the ARI Standard. The seal may be displayed on the equipment as well as on specifications, literature, and advertising. ∓

N. Y. Cooled Office Space Passing 50 Percent Mark

. . . contractor's survey shows

A SURVEY of 93 million sq ft of major New York City office space in 433 existing structures and buildings under construction reveals that air conditioned space in the city is passing the 50 percent mark.

The survey, made by Hudik-Ross Co., mechanical (heating, piping, and air conditioning) contractor, covers 12,178,000 sq ft of space in 20 new buildings under construction, 25,530,000 sq ft in 90 completed postwar buildings, and 55,303,000 sq ft of major space in 323 prewar buildings. Major office space, according to the Real Estate Board of New York, represents 83.5 percent of the total assessed value of all office buildings in Manhattan.

The study showed that when the 20 buildings now under construction are completed, 51 percent of major office space in Manhattan will be air conditioned. ∓

Man's Days Numbered Unless He Mends His Ways

. . . Doctor tells APCA

"MAN'S DAYS on earth are numbered if he keeps dirtying-up his planet," Dr. Rex H. Wilson, medical director, B. F. Goodrich Co., told the recent annual meeting of the eastern central section of the Air Pollution Control Association, in Akron.

"Humans have the unfortunate ability to contaminate everything with which they come in contact. Science must teach us how to decontaminate ourselves and our surroundings. If not, we will eventually find our world so polluted that we cannot live on it.

"It is no longer news that man-made smog can be constantly annoying and occasionally lethal," Dr. Wilson said. "The fact that every large city in the world may be plagued with these conditions in the future creates a problem for the physician as well as the air pollution control scientist." ∓

HPAC Index for 1958 Available Soon

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FOR YOUR convenience the editorial contents of Heating, Piping & Air Conditioning, including the Journal Section of the American Society of Heating and Air-Conditioning Engineers, are indexed annually. The 1958 index, now in preparation, will be available to subscribers early in 1959.

To obtain your free copy, write the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill. ∓

"Quote"

"If we don't keep our men trained to handle the technical equipment of today, we're sunk in our efforts to train men to handle the technical marvels that are coming."—*Ralph G. Smith, Dow Chemical Co., speaking at the recent semi-annual meeting of the American Society of Mechanical Engineers in Detroit on the need for stepping up on-the-job training for all types of technical personnel.*

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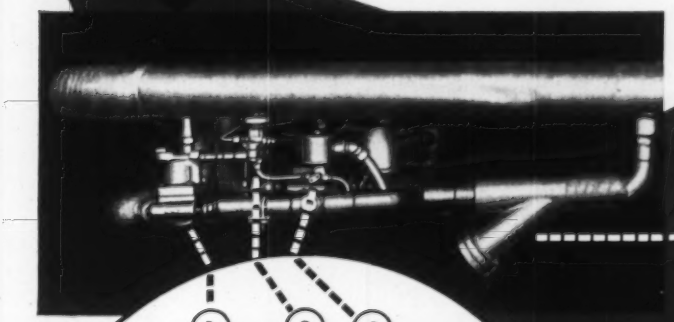

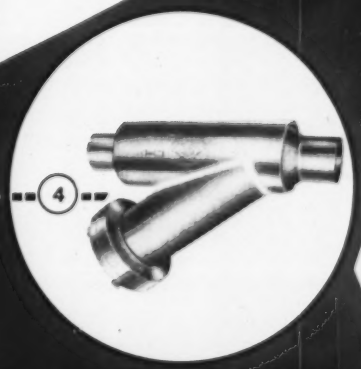

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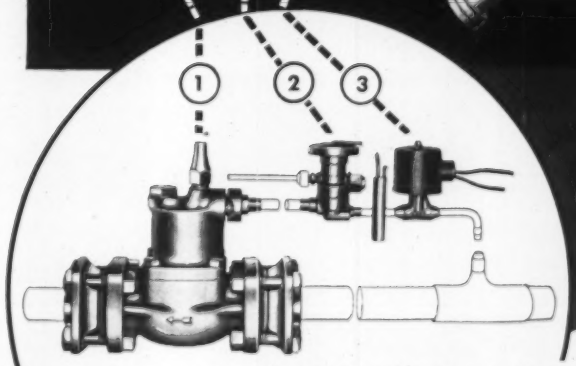

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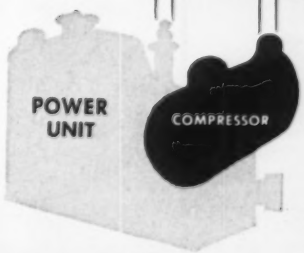

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"Open for Discussion"

• *WE FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

Terminology Should Distinguish Between *Hot* Water, *Warm* Water

ANOTHER CONSIDERATION regarding the terminology for heating and piping systems where the medium is water of either lower temperature at atmospheric pressure (vented nonpressurized systems) or higher temperature at pressures above atmospheric (closed circuit pressurized systems), is to call the former *warm water* systems (*WW*) and the latter *hot water* systems (*HW*).

To designate systems with the different higher than atmospheric pressure ranges in greater detail, one merely has to follow the suggestion of E. C. Hansen ("Open for Discussion," July) and add the descriptive letters to the *hot water* systems, namely *HPHW*, *MPHW*, and *LPHW*. One usually knows in advance which pressure system is under discussion.

In the basement of a high building one may encounter warm water at a high pressure, but could never use a term such as *high pressure warm water* to denote the system concept.

Therefore the nomenclature should distinguish the systems as being either *hot*, which means pressurized, or *warm*, which is atmospheric. In addition then, to denote the different system ranges, one could use *high*, *medium*, or *low pressure* or *high*, *medium*, or *low temperature* — the word pressure being, of course, much preferable as it reinforces the meaning of the basic condition for *hot*, repeat *hot*, water systems.

In the German language for years no other terms are heard than "Heizwasser" (hot water) or "Warmwasser" (warm water) to differentiate between the two concepts of water heating systems.

LEO DE BRUYN
Minneapolis-Honeywell Regulator Co.
Zurich, Switzerland

"Morse Code" Rapping Could Exist, But Would Be Readily Detected

WE WERE interested in Lester S. Ries's comments ("Open for Discussion," August) on the article *Prison's Heating, Ventilating Systems Meet Maximum Security Needs* (June).

We agree that a method of "Morse Code" rapping would be possible through the ventilation ducts. This would not apply between two cells on the same floor, since the rapping could be readily heard through the day room area and the use of the ducts would be unnecessary. It would be extremely difficult for the rapping to be heard between floors, although anything is possible in an institution of this kind.

With regard to the control problem, the designing engineers recognized the problem of radiant heating plus glass block fenestration. To overcome this problem the radiant heating was designed to supply a basic temperature of 60 F, with the remaining 10 F deg plus control obtained by heating coils in the ventilation system. This proved to operate quite successfully last winter.

JOHN H. ROSS
John H. Ross & Associates, Ltd.
Consulting Engineers
Toronto, Ontario, Canada

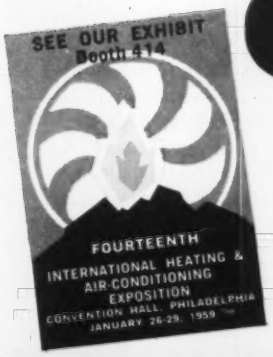
Answer Writer's Queries on Design Of Asbury Hospital Air Conditioning

IT WAS a pleasure to read John Holbrook's comments ("Open For Discussion," October) to my article *Design New Hospital Heating, Air Conditioning For Expansion* (June). While I'm sure everyone who is associated with determining air conditioning system design realizes that the subject can be discussed at great length, I will endeavor to answer Mr. Holbrook's comments in their listed order.

1) Using his terminology, we agree with Mr. Holbrook, "that dewpoint control with reheat system gives the most satisfactory results." As to installation costs, our experience has proven otherwise. We have found that other systems are more difficult to incorporate into a building — some types actually requiring more space rather than less as advocated. Unless quality is sacrificed they are more expensive to install, at least in new buildings, and sometimes they are more expensive in existing buildings.

2) The only operating saving that can be effected by other than dewpoint control with reheat is to sacrifice maintenance of space relative humidity. This can become objectionable at less than design loads for exterior spaces and can be always objectionable for interior spaces which have low sensible to total heat gain ratios.

Conventional velocity systems with reheat control are inherently less expensive to operate than certain



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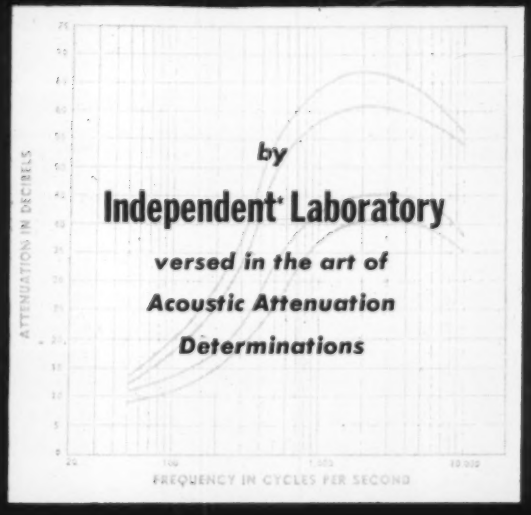

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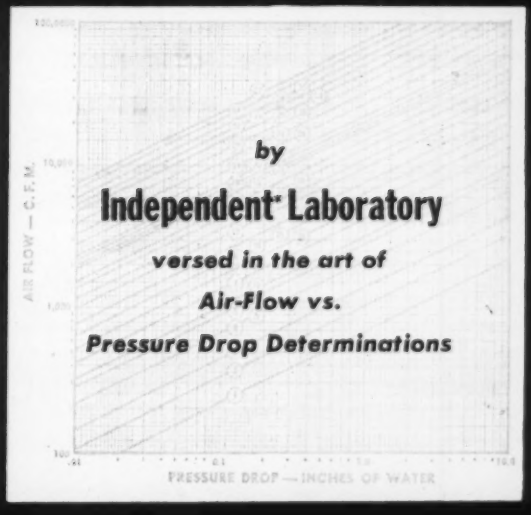

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* *"Recognized" should mean acknowledged or skilled in a specific field.*

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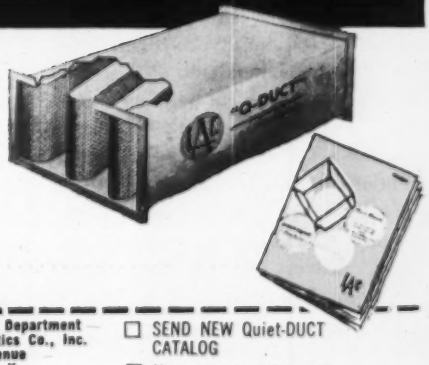

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high velocity systems which, to achieve the same final space conditions, must necessarily have more refrigeration effect to offset the expensive continuous electric reheat which results from the greater energy input to the supply fans. These high velocity systems are also more expensive to operate because the inherent reheat in the fan requires that the refrigration effect be operated more hours of the year than with conventional velocity systems. These features do not include the higher fan operating costs which operate every day of the year.

Conventional velocity central systems with reheat are, from our experience, less expensive to operate than the so-called unit type systems employing primary air for ventilation, filtration, dehumidification, and humidification, plus chilled water at each space for the balance of the cooling load; all features being necessary to compare qualitywise with the central systems except that the conventional velocity central systems have a considerably lower noise level and are therefore more desirable. The reason they are more expensive to operate is because, as conventionally designed, they have higher pumping costs and more overall yearly ton-hour refrigeration operation to meet system requirements until winter changeover can be made which is at a reasonably lower outside temperature than is the case with all-air systems. Also the maintenance costs are higher with the unit type systems.

3) The system we employ has the same location of coil and valve for the patient areas as Mr. Holbrook describes, i.e., "under the window stool location." As a further comment we would like to add that with numerous projects of all types easily exceeding a million cfm with individual room reheat control we have yet to receive a complaint as to the accessibility of a reheat coil and valve location, most of which are in suspended ceiling spaces. Still another point is that the units employed in the Asbury Hospital patient areas require almost no attention as compared to filter cleaning, coil cleaning, nozzle cleaning, condensate drip problems, and/or noise problems associated with either of the so-called unit type systems.

4) While manufacturers of air conditioning equipment stress savings in building cubage with the use of specific systems, our experience has proven that some of these systems actually require more space than conventional central systems with hot water reheat. This is especially true for the types of systems which can be applied to other than patient room areas, i.e,, surgery, delivery, x-ray, lab, and sometimes other areas in the modern air conditioned hospital which often are interior spaces or exterior spaces without windows. To satisfactorily condition such areas some type of reheat system or at least a cooling coil bypass system requiring dual ducts is required. It is our experience that, regardless of how high the velocities may be, dual duct systems require more space than conventional velocity systems and reheat piping.

Areas which can effect a small saving in space requirements for ducts and pipes, providing the right systems are selected, are those which are basically uniform multi-room, multi-story areas. In the modern air conditioned hospital such areas are usually patient floors only. Since the patient area amounts perhaps only to 20 to 25 percent of the total area of the hospital, the total cubage saving which might be effected is not significant. Also, since many areas of a modern hospital have ventilation needs that exceed the heat gain requirements, regardless of the type of system used, to achieve satisfactory final conditions no saving in space can be economically effected over and above the central system with reheat.

5) We agree with this comment and add only that we find that different hospitals vary the type of care in their recovery areas. Therefore the type of air conditioning necessarily varies.

WILLIAM STURM
Ellerbe and Co.
Architects and Engineers
St. Paul, Minn.

Coil Freeze-up Article Long Overdue; Hope More Information Is on the Way

H. W. ALYEA's article, *Why Steam Coils Freeze,* (April and May) was long overdue. I note with interest that additional related items are to be covered soon. I certainly hope these articles will appear in the immediate future and be tied in to the earlier article.

I think several important points were omitted from Mr. Alyea's article, however. At the very beginning, he mentioned the stratification problem, but he didn't mention one of the reasons why this is more of a problem today than it used to be with pipe or cast iron coils.

As stated in his article, usually these heaters were used in multiple banks and as most of these systems were installed in the days before cooling was considered, the design face velocities used were frequently in the 600 to 800 fpm range. This design approach resulted in an appreciable air pressure drop across the heater bank and a relatively even air flow across the face of the coils.

According to Mr. Alyea's article, with the introduction of nonferrous transfer surfaces in the 1920's the number of banks required was greatly reduced. Although the number of coils frozen increased, the problem didn't become acute until the late 1930's because engineers and coil salesmen tended to retain their old habits of banking coils with relatively low temperature rises and using higher face velocities.

With the advent of cooling, the design face velocities dropped, permitting the entire load on heating to be handled with one coil more frequently and reducing the overall air pressure drop through the coils. I have seen some jobs operating at face velocities in the vicinity of 300 fpm with air pressure drops of about 0.10

in. water gage with outdoor and return air dampers located close to the coils. This invariably resulted in uneven air flow over the coil face as the dampers modulated and, ultimately, stratification.

I don't claim that higher face velocities are a cure-all for the stratification problem, but they would help in many cases. Sometimes, with higher face velocities, two coils would be required instead of one. But about the same total amount of surface would be purchased and, as explained by Mr. Alyea, two coils deep in the direction of air flow can be controlled better with less chance of freezing or overheating than one coil.

Mr. Alyea's discussion of the temperature gradient problem with conventional coils (nondistributing type) is excellent. However, he did not point out that several coil manufacturers have spent considerable time developing and cataloging low temperature rise coils that can be used with higher steam pressures and lower face velocities and still give only moderate temperature rises of 15 to 25 F deg, so the coils can be banked without overheating in mild weather.

In the discussion of distributing tube coils, only two types were specifically mentioned and the existence of a third was inferred. I believe everyone could understand the distribution problem (freeze problem, also) better if more types of distribution coils were described.

The most common distributing type coil is the orificed tube-within-a-tube coil, with the supply connection on one end and the return connection on the other. This was one of the first distributing type coils to be developed. I believe most coil manufacturers will now admit that this coil has some limitations. One of these coils of any size, with large enough orifices located close enough together in the inner tube to handle a heavy load, cannot satisfactorily distribute the steam on light loads (modulated). The temperature gradient curve will look like the curve in Fig. 1 in Mr. Alyea's article, although the slope of the line *AB* will not be as acute. This type of coil will be quite safe from freeze-up if the tube length is kept relatively short and the coil installed with the steam supply at the top and the return at the bottom, with vertical tubes.

Another distributing coil is the return-bend type without an inner tube, which Mr. Alyea described. This coil works fairly well from 100 percent to 50 percent modulation if sized correctly and the coil isn't too long. When modulation below 50 percent of capacity is attempted with this coil the low temperature rise problem shown in Mr. Alyea's Fig. 1 shows up again. Of course, a coil of this type without plate fins wouldn't be very good from the standpoint of distribution and freeze protection.

A third distributing type is the tube-within-a-tube coil with the connections on one end, also mentioned by Mr. Alyea. This coil is offered in types with orifices in every tube, without orifices, and with either the second or every third tube orificed. Without orifices this coil provides maximum freeze protection and a fairly good temperature gradient curve. The far end tends to be hotter than the supply end under light loads, but the steam must go through the cool end of the coil to reach the far end, thereby making freezing this coil difficult. This design doesn't depend on transfer through the fin for freeze protection as does the return bend coil mentioned previously, and will give fairly even discharge temperature from 100 percent to 40 percent modulation.

The tube-in-a-tube coil with orifices and connections on the same end isn't any better on distribution than the tube-in-a-tube coil with orifices and connections on opposite ends, but this coil is a very poor coil as far as freeze prevention is concerned because, under light loads (modulation), the steam emitted from the orifices at the supply end tends to block the condensate from leaving the coil. The result is ideal freezing conditions.

The tube-in-a-tube coil with connections on one end and every other tube orificed gives the best distribution under all loadings but isn't quite as good from the freeze prevention angle as the non-orificed coil. This coil is one of the better types available at the present time.

An even better distributing coil is the orificed tube-in-a-tube coil with the supply connections on both ends and the return connection on one end. This coil performs excellently when long tube length coils are required, but the additional cost to pipe two connections isn't warranted for short tube length coils.

Another relatively new type of distributing coil has a tube-within-a-tube with orifices and a return bend on the far end for the inner tube only with all connections on one end. From many theoretical considerations this should be an excellent coil, but for short and medium tube lengths I doubt that it will give any better distribution or freeze protection than the other orificed coils described; and for long tube length coils with heavy loadings the coils with the supply connections on both ends should give better results. This is again one of the better types available.

One important point regarding freeze protection of coils which Mr. Alyea hasn't covered is the need for accurate sizing of everything in the system when designing outside air systems. On several occasions in my contracting days, I found the ventilating and heating loads were calculated and a safety factor added. The coils were then specified from some coil manufacturer's catalog and the capacity exceeded the loads previously determined because they couldn't be matched perfectly.

The coils purchased were not the coils specified and all exceeded the specification requirements on capacity. The control manufacturer selected and sized the control valves with a safety factor to handle the capacity of the coils which were actually furnished and the valves were from 35 to 55 percent oversized for the actual building load. The result after installation was that the first 35 to 55 percent of valve closing didn't reduce the

coil capacity at all and actually, in moderate weather (20 to 35 F), the valves performed like two position valves. Possibly, Mr. Alyea could cover this problem in more detail. His discussion of parallel control valves and controlling outdoor air quantities is excellent.

W. B. Buck
Field Sales Manager
McQuay, Inc.
Minneapolis, Minn.

The Author's reply — Mr. Buck's comments are very welcome and certainly will add to the general knowledge of the subject. Coil freeze-up is of such concern to everyone on the heating, ventilating, and air conditioning industry that I am sure there must be others who can also contribute additional valuable information. Again I can only say, as I did in reply to the comments of Lewis Smith ("Open for Discussion," September), it was hoped that the original articles would stimulate considerable discussion in these pages to the benefit of all of us.

H. W. Alyea
Director of Engineering
Johnson Service Co.
Milwaukee, Wis.

Clarify Conditions Which Caused Air Conditioning "Sweat" Problems

The comments on my article *What to Watch For When Insulating Air Conditioning Systems* (August) offered by James H. Shaw ("Open for Discussion," September) are most interesting and do require an answer. Mr. Shaw is assuming that some of the failures studied were caused by moisture absorbed into the insulation. This is not the case. Each trouble mentioned in the article was caused by either an excessively high dewpoint or a depressed dry bulb or both. Troubles caused by poor insulation, whether by moisture absorption or otherwise, were omitted intentionally.

Mr. Shaw is right in saying that a poor or broken vapor barrier on the insulation can cause considerable trouble. But under normal use the flexible foamed plastic insulation with its very low moisture permeance or the cork with its vapor barrier will not pick up enough moisture to cause a measurable change in its effectiveness. Moisture samples were taken from several of the installations studied and these samples were found to be dry.

The original, more comprehensive paper from which the article was abstracted brought out these points in greater detail. Mr. Shaw is right when he says that competent engineering could have prevented most of the problems discussed.

This study points up the fact that a vapor barrier membrane should always be used between the ground and the building if this building is to be built in any but arid and semi-arid areas. The installation of a polyethylene or other good vapor barrier film is inexpensive insurance against the influx of ground moisture, the largest source of moisture in most buildings.

I wish to thank Mr. Shaw for his remarks and invite additional comments from others.

Charles F. Gilbo
Research and Development Center
Armstrong Cork Co.
Lancaster, Pa.

Here Are More Ways to Build Reliable, Efficient Library

Earlier this year the Question of the Month asked for readers' opinions on what is the best way to set up a technical reference library. The following procedures have been employed for some time and have proved to be reliable and efficient.

Manufacturers' catalogs, manuals, and similar literature having hard covers have code numbers and letters stenciled on the outside of each cover for identification. A separate card system listing catalogs by manufacturers' names and assigned numbers allows easy identification. Another card system listing literature by product, name of manufacturer, and catalog number is also employed. Use of both card systems provides a cross-index, permitting quick and accurate identification.

Data sheets, bulletins, and thin paper covered catalogs are kept in fiber pockets. The latter have typed labels for ready identification of subject matter. Each pocket contains literature pertaining to one category only—such as centrifugal fans, rotary pumps, boilers, etc. A card system similar to that used for the hard bound literature is also employed for these items.

Magazine and technical journal articles are kept in binders according to subject. A separate card system listing title, author, magazine source, and date of publication provides an index of available subject matter.

Textbooks and handbooks have numbers stenciled on their covers. A card system containing title, author, publisher, edition number, and date of publication provides a quick index.

The methods described offer reliable means for identifying technical literature used in an engineering office. It is recommended that catalogs and other literature be kept up to date. Old copies should be discarded as revised editions become available. Frequently, the former are a source of obsolete information. Also, discarding old editions reduces the need for larger space requirements.

H. B. Wayne
Consulting Engineer
Woodhaven, N. Y.

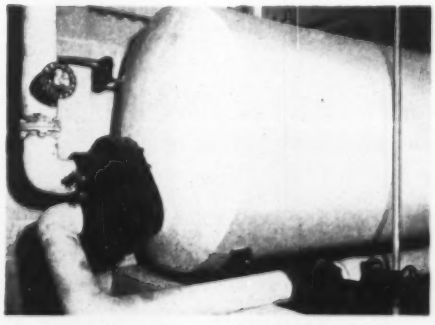
The photos on pages 98 and 99 in the November issue appeared through the courtesy of Grinnell Co., Inc.

Where quality counts . . .

Specify RECO

General Contractor, Atlantic Construction & Engineering Co.; Mechanical Contractor, Cross Plumbing Co., Ft. Lauderdale; Engineers, Obolar & Clarke; Architects, Gibbs & Mackay; RECO Representative, Essex Heating & Air Conditioning, Miami.

TWO RECO CEMENT-LINED HEATERS SERVE NEW GALT OCEAN MILE HOTEL



From window glass to heating system, *quality* was the keynote at the beautiful new Galt Ocean Mile Hotel. This luxurious $3,000,000 building is the first of 25 new hotels to be built on a one mile, $19,000,000 stretch of beach inside the city limits at Fort Lauderdale, Florida.

Of course *delivery* and *price* were important factors, too. Two RECO Cement-lined Hot Water Storage Heaters (48" x 192" and 48" x 264") "more than adequately" met all three of these requirements according to William D. Cross, Mechanical Contractor.

RECO offers you a complete line of heat exchange equipment—all ASME inspected and guaranteed. Write for 20-page storage heater catalog showing dimensions, diagrams and details. Address RECO, Dept. C, 7th and Hospital Sts., Richmond 5, Va.

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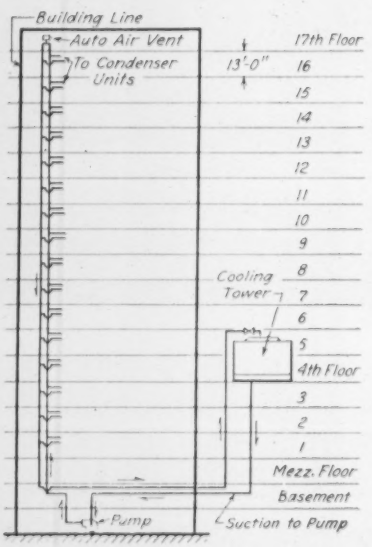
Question of the Month

What Is Correct Pump Head For Cooling Tower Piping?

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Other answers to this question appeared in Question of the Month in the October and November issues. Other comments for publication are invited.

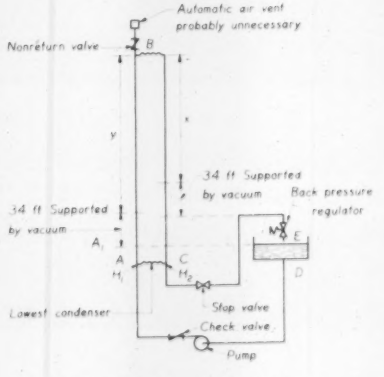
"I have a problem of accurately determining the pump head for the piping system where cooling water is pumped from a sub-basement to condenser units on all of 16 stories and then to a cooling tower which has the water inlet on the fifth story level. See the drawing below.



I would appreciate any suggestions that others may have on how this problem may be solved."—J.A.W.

Head = Resistance of Flow in Piping + Lift + Condenser Resistance

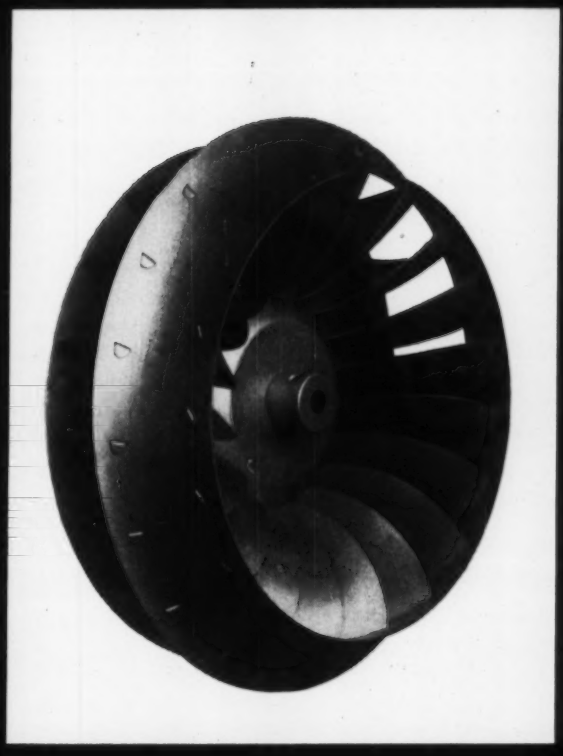
THE PROBLEM of pump head calculation is one which frequently crops up in air conditioning. My solution is illustrated in the drawing below. The working pump



Stop valve should be closed before shutting down pump in order to prevent water running down from risers and overflowing tank

head should equal the resistance of the flow piping *DAB*, plus lift *y*, plus the resistance of the condenser. The pumps will also have to provide the velocity head of the water, and must be capable of lifting from A_1 to *B* on starting up.

The return pipe *BCE* will operate by gravity and the resistance should be equal to head *x* to avoid cavitation at *B*.



TORRINGTON CRACKS THE NOISE PROBLEM The squeeze toward compactness in room air conditioners has forced the decibel level up to the point that *noise is now the No. 1 problem.* ▌ In anticipation of this trend, two years ago Torrington's air impeller laboratories went to work on "noise." ▌ The result is the revolutionary Torrington H Wheel—one of the most important breakthroughs in air conditioning history. ▌ In one room air conditioner application test the H Wheel reduced the noise level from 63 to 53 decibels; and it was less than *one half as loud.* ▌ Torrington's engineering department is now offering samples of the H-Series Wheel for evaluation in your new product development program.

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$\frac{1}{2}$

It will be of interest to check the working pressure difference across the lowest condenser connections as follows:

H_1 = head y + friction A to B and condenser resistance

H_2 = head x − friction B to C

$H_1 - H_2$ = $(y - x)$ + friction A to B + friction B to C + condenser resistance.

It is therefore recommended that ABC be sized for low friction, or a back pressure regulator possibly used at E to absorb the surplus.

JAKE CUTHBERT
Mechanical Engineer
Oscar Faber & Partners
Consulting Engineers
London, England

Some Earlier Answers Overlooked One Vital Factor: Heads Won't Balance

IT SEEMS to me that an important factor was completely overlooked in the answers to this question in the October issue. As far as I can see, the static heads will not balance each other. Here's why:

In a system such as is shown in Fig. 1 the hydrostatic heads will balance. However, in a system like

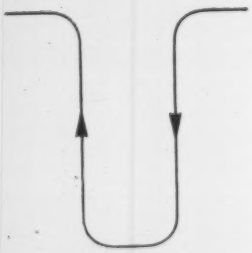


Fig. 1

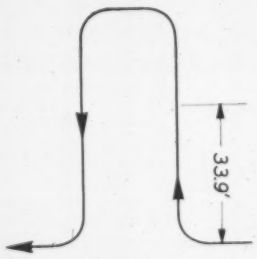


Fig. 2

the one shown in Fig. 2, there can never be less than vacuum above the right riser. Thus, the pressure difference can never be more than 1 atmosphere and the water will not balance more than 33.9 ft. The rest of the riser has to be taken care of by additional pumping pressure.

Assuming 100 ft between the sixth and 16th floors in our particular problem, we will have to add at least 100—33.9=66.1 ft to the pumping head and probably much more in order to get good circulation. This extra head would, of course, be added to the other heads already indicated in the October answers.

PER ESKILSON
Mechanical Engineer
Far Rockaway, N.Y.

Sufficient Head Must Be Provided To Raise Water Level to 175 ft

J. A. W.'s QUESTION seems to be a matter requiring further consideration. An automatic air vent installed at the top of the loop can let air into the system as readily as release it. Consequently, with an opening at the top of the system and another at the cooling tower, this cannot possibly be considered to be a closed system.

The replies in October fail to consider that sufficient head must be provided by the pump to raise the water level 175 ft, more or less, above the cooling tower basin on the fourth floor level. To this must be added all the friction losses in the supply pipe and condensers. With the reverse return system recommended by Antonio Di Lorenzo, as shown in the October issue, and hereby endorsed, some additional head is required to overcome resistance to the top of the reverse return loop. The arrangement shown appears to be adequate to assure a positive pressure at the automatic air vent.

Some means for restricting the flow in the return line is desirable so this line will run full and never be under vacuum. The solenoid valve and check valve suggested by John Belunas will be of considerable value in maintaining the system free of air, provided they can be maintained so as to shut off tight.

Pump head requirements will be equal to the static difference between the level in cooling tower basin and the highest point in the pipe system, plus resistance of supply piping, plus resistance of condenser circuit, plus resistance of return pipe from condenser to top of reverse return loop, plus 10 ft (more or less) to assure positive pressure in the pipe at the air vent valve. If the return pipe is restricted to have more than 10 ft greater friction drop than the static head in that pipe, then the extra friction so created must also be added to the pump head.

It should be noted that the sum given above is pressure differential which must be produced by the pump. It should not be confused with the pump discharge pressure, which will be greater.

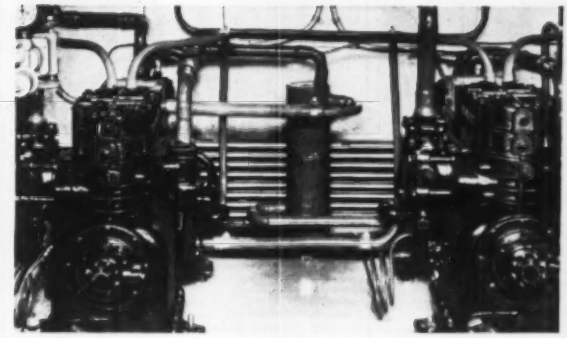
S. A. LITTMANN
Chief Mechanical Engineer
Giffels and Rossetti
Architects and Engineers
Detroit, Mich.

READER ASKS —

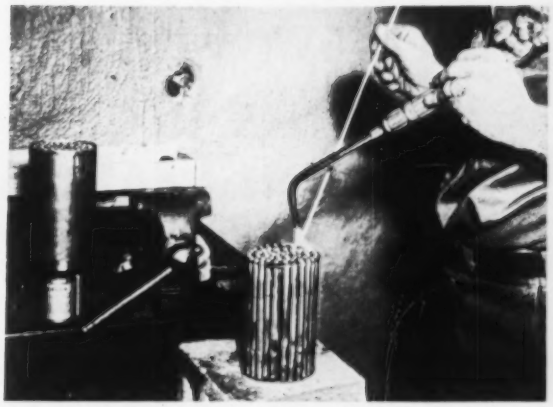
"What Is Best Location For Induced Draft Fan?"

"I would like to know how the best location for an induced draft fan can be determined. Also, what factors should be considered in positioning the fan after the location has been selected."—D.H.S.

• *YOU ARE INVITED to contribute a question for publication or an answer to a published question. Write: The Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

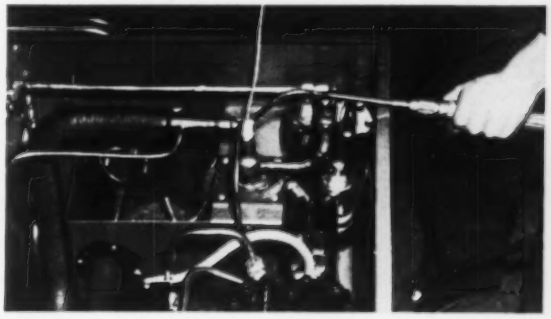


Here is a cascade refrigeration system using Freon 22 and Ethane refrigerant. This system cools five gallons of oil per minute to minus 70° F. All of the refrigerator tubing on both high- and low-pressure sides is brazed with SIL-FOS (approximately 185 joints). Some joints fluctuate in temperature from minus 200° F to plus 70 or 80° F.



Here, operator brazes the tube bundle before assembling it in condenser shell. Hand gas-air torch keeps the SIL-FOS flowing freely.

Now the tube bundle is being brazed to the sheet by the same simple heating method.



Operator puts finishing touches on last joints of small two-stage unit.

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Time, strength and leak-tightness are, by themselves, excellent reasons for specifying SIL-FOS. There are many more. Like brazing's inherent economy. Like the ease and speed with which joints are made. And like the quality SIL-FOS joints assure your product. We would like to give you all the necessary brazing background you may require . . . call us.

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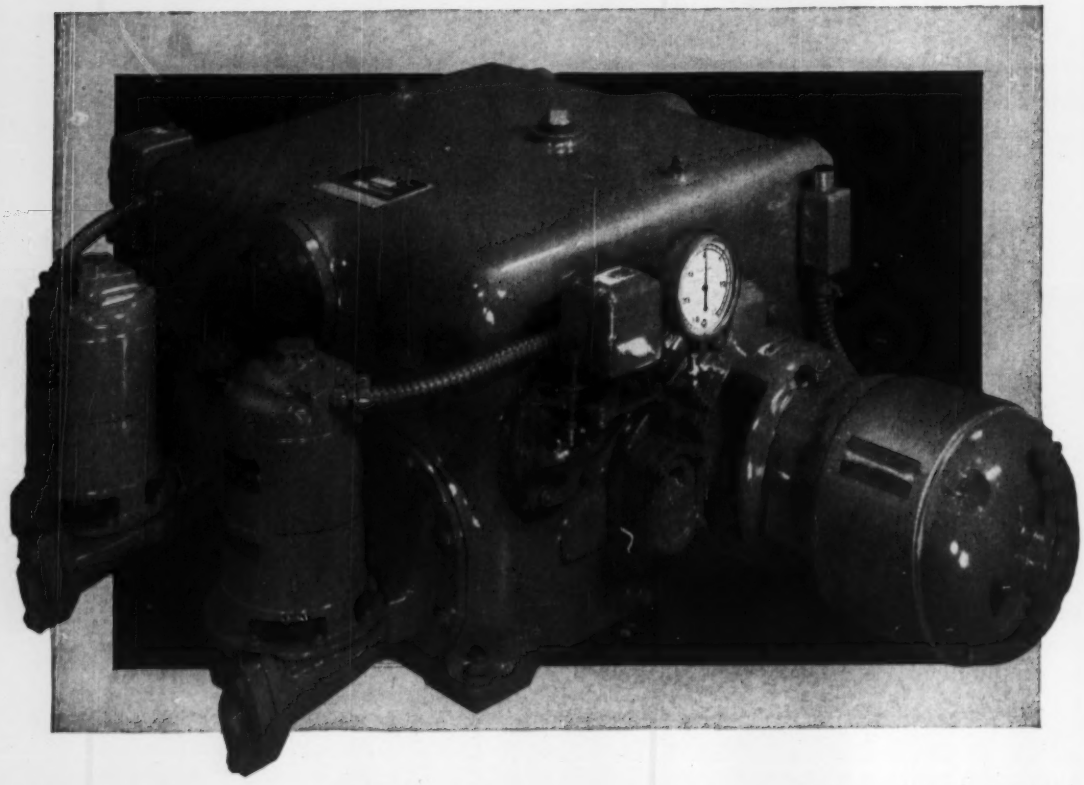
THIS NEW VACUUM HEATING PUMP

HAS THE INCREASED AIR CAPACITY EFFICIENT HEATING PRACTICE DEMANDS



It's the Nash CSM

Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
437 WILSON, SO. NORWALK, CONN.

DIFFUSERS, RETURN AIR INTAKES, lights are concealed above aluminum honeycomb ceiling. Arrangement does not impair air distribution, adds to appearance of 92,000 sq ft of ceiling in new Reynolds Metals Co. general office building

New Air Distribution Technique Hides Diffusers Above Ceiling

. . . to give office areas a new look

BY ROBERT B. HUPPER
Mechanical Engineer
Ebasco Services, Inc.

WITH THE design of the new $11.5 million Reynolds Metals Co. general office building in Richmond, Va., a new air distribution technique was born. The recently completed structure features a unique method whereby heated or cooled air is admitted through diffusers above an aluminum honeycomb ceiling which gives the effect of a canopy of delicate lace.

The design of this new air distribution system was a challenge early in the planning of the building. It was required that a major portion — 92,000 sq ft — of the then proposed structure have a false grid type ceiling. Multiple rows of tube type fluorescent lights, mounted in a continuous arrangement, were to be installed above it.

Because light and radiance were key considerations, shadows had to be eliminated — there could be no interplay of light and dark. Accord-

ingly, the diffusers, ductwork, and return air intakes — all normally mounted exposed just below the ceiling — had to be installed *above* the lights and *above* the ceiling. Technically, this was an unusual and rather perplexing demand.

Additional decorative demands were made, and this is the packaged problem with which the engineers were confronted:

1) Functionally, the diffusers, though completely concealed above the honeycomb ceiling, must guarantee proper air distribution.

2) Decoratively, the diffusers, where necessarily exposed in plastered ceiling areas, should hardly reveal their purpose, by conforming with the planned interior.

Problem Was Three-Fold

In the grid ceiling areas, the major problem was a three-fold one of air supply, distribution, and control:

1) To supply air from the diffusers located above the lights

2) To exhaust air through intakes which also were to be above the lights

3) To maintain an even temperature without drafts in the working areas below.

The problem was attacked from all perspectives with various air distribution theories, systems, and processes. Finally, this solution was proposed and tested:

A single stream air diffuser which delivers a high velocity jet was selected because it distributes air in an effective single stream pattern, eliminating drafts and equalizing room air temperature by a high induction rate. These units had to have calibrated sleeve dampers which would assure precise air volume regulation.

It was believed that the high degree of air entrainment produced by this single stream diffuser would make the location of return air intakes considerably less crucial. Out of the total room air, about seven times the primary supply air volume would be entrained and set in motion to mix thoroughly with the air in the zones occupied by workers.

Another portion of air, about equal to the primary supply air volume (one-eighth of the total air in motion), could then be exhausted. The remaining air in motion then would continue to mix with the room air and provide the occupied areas with efficient, uniform air conditioning.

Erect Typical Building Module

To test the theories and determine the actual performance of this proposed air distribution system, the diffuser manufacturer was contacted and the following tests were conducted in his laboratory:

For a typical module of the building, a test room was erected. The room was made 20 × 12 × 15 ft high. It had a 9 in. thick ceiling, the bottom of which was 9 ft, 6 in. from the floor. Five rows of lights, each row 12 ft long, were installed above the ceiling, exactly duplicating expected job conditions. A typical low pressure duct, with 9 in. diffusers mounted on collars beneath it, was installed above the lights. No attempts were made to minimize obstructions.

Two openings representing return air intakes were made in the opposite side wall at the same height as the diffusers. A temperature differential of 20 F deg was obtained. Air temperature readings were taken at seven different locations and at six different heights within the room, or at 42 different points.

Results Prove Satisfactory

The test results were conclusive and very satisfactory. The lowest air temperature was 74 F, found at one end wall. The highest temperature, 76 F, was found near the room's center and at the other end wall, and was also found to be the temperature of the return air.

Excellent room air mixing was obtained. Also, it was proved that neither grid type ceilings nor lighting tubes were obstructions to proper air diffusion, as it previously had been believed. Both theory and test results have been further substantiated by actual operating experience. The system has been completely sat-

SYSTEM of 880 giant color anodized aluminum sun louvers shield eastern, western faces of building from heat and glare to reduce cooling load. Louvers are geared to astronomical clock which anticipates sun's movement

isfactory since October, when the new building was officially opened.

Air diffusers, indispensable to most large air conditioning systems, have often been instruments of decorative crimes. Here, it has been demonstrated that they can function properly even when hidden above a grid type ceiling.

Use Zoned Air System

Since the building is totally enclosed with fixed glass panels, the reliability and efficiency of the heating, ventilating, and air conditioning system are of primary importance. To accommodate the architectural and occupancy requirements, it was decided to use a zoned air system with booster heaters in the ducts.

Provision was made for individual thermostatic controls as required for complete flexibility now or for any future office arrangements. Perimeter heating is achieved through hot water convectors in aluminum grilles under the glass panels. These convectors are controlled by an outside thermostat so as to be more responsive to variations in the outdoor temperature.

Air distribution is accomplished by 10 separate fan systems with a total air flow rate of 292,400 cfm. These fan systems take outdoor air from a common plenum, the intake grilles for which are in the first level terrace at the northeast corner of the podium. This air is cooled or heated as required, filtered, dehumidified, and distributed throughout the building in aluminum ducts which are acoustically treated to maintain a low level of equipment noise.

Louvers Intercept Sun's Heat

Sun louvers serve a very real purpose in air conditioning by effectively intercepting the heat of the sun outside of the building. By protecting the glass walls from the rays of the sun and providing proper ventilation between the louvers and the glass, the heat load is substantially reduced on the critical east-west exposures. The end result is that air conditioning costs are reduced enough to write off a large portion of the louver cost.

The system — with a total area of 21,355 sq ft — is believed to be the largest sun louver installation in the world. Operated by two 7.5 hp and two 5 hp motors, it is governed by a complex control system.

The installation has 880 louvers, each 14 ft tall, 22 in. wide, and with a cross section resembling a flat diamond 3 in. thick at the center.

The louvers change position several times during the day. Their rotation is only slightly in advance of the sun's movement so that minimum restrictions are placed on view and entering daylight. The proper timing and amount of adjustment was determined through a study of daily and seasonal movements of the sun.

Seasonal changes in sun angles require periodic corrections in the daily program of louver movements. These corrections are made automatically by a master clock so that the louver operation is automatic the year 'round. Barring power failure, the master clock will keep the control system properly adjusted until about 2100 A.D.

The control system also provides for cloudy weather. Reduced light intensity from cloud overcast will cause photoelectric units to countermand (after a 3 min time lag) the program control of the louvers and turn them perpendicular to the building to admit maximum light. Return of clear sunlight lets the program control system take over, and the louvers automatically move to their proper time positions.

Heat With Oil Fired Boilers

Heating for the building is provided by two 300 hp steam boilers with capacities of 9.5 million Btu per hr each. Each boiler has a horizontal rotary oil burner with automatic gas ignition and burns No. 6 fuel oil. The oil is stored in two 15,000 gal tanks underground. Estimated annual fuel consumption is 236,000 gal.

Fuel oil is preheated by a steam heater with an auxiliary 42 kw electric oil heater for standby operation. The oil heating unit is capable of delivering 500 gph of oil at a discharge pressure of 50 psi with only one pump operating.

Booster coils and reheat coils in the air distribution systems are supplied by a steam-hot water converter supplying 33,100 gph. All are thermostatically controlled.

Direct heating for the building is furnished by one steam-hot water converter which supplys 26,500 gph to baseboard fin type convectors located under windows in the cafeteria, on the second and third floors, in the solarium, and in the penthouse.

Provide Finger Tip Control

From a central control panel, building engineers have finger tip control over heating and air conditioning in the new building. The 32 ft long panel allows a single building engineer to continuously check and log temperatures and other data from all parts of the building, adjust remotely located equipment and control devices, start and stop heating and air conditioning equipment, quickly make basic adjustments in temperatures in any area of the building, and supervise flow in the fire alarm sprinkler lines, providing instant warning of fire or failure in sprinkler equipment.

Schematic layouts of various equipment systems are shown on the portions of the panel governing those systems, with control instruments located in the appropriate part of the layout. A system of indicating lights also shows whether the various pieces of equipment are functioning properly.

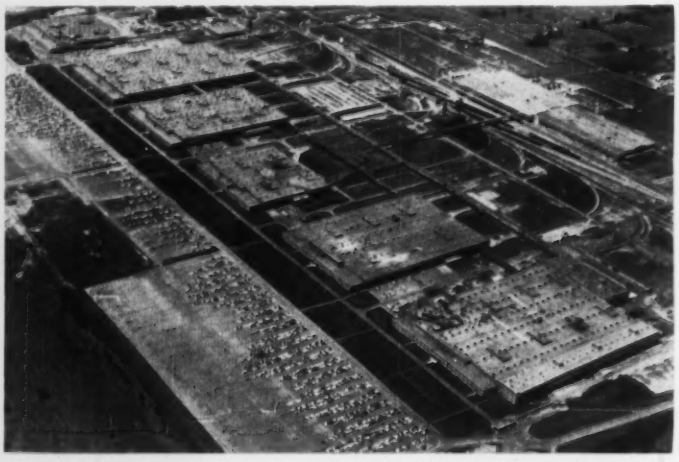
Without such a control center, the same supervision of heating and air conditioning would require a crew of eight maintenance men taking temperatures and making adjustments in various parts of the building.

Architects for the building were Skidmore, Owings & Merrill. Ebasco Services, Inc. was the consulting engineer. The mechanical (heating, piping, and air conditioning) contractor was Huffman-Wolfe Southern Corp. ‡

Photos courtesy Connor Engineering Corp.

PUMPING STATION consists of 4 million gal reservoir storage. Water is chemically treated and spray cooled (when necessary) prior to its re-use. Seven 400 hp vertical turbine pumps provide circulation. Water leaves station at about 140 psi, flows back under gravity

GE's 'Mill Water' Piping Saves $500,000 a Year



APPLIANCE PARK, built at a cost of better than $200 million, is one of the largest manufacturing centers in the U.S., comprising buildings housing six of GE's major appliance departments, a large warehouse, and numerous smaller service buildings. In all, more than 5 million sq ft of floor space is enclosed on an almost 1000 acre site 8 miles south of Louisville.

BY JOHN VONDERHEIDE
Manager, Plant Engineering
Appliance Park
General Electric Co.

How to cut an anticipated annual water bill in excess of $1 million? This question faced General Electric Co.'s plant engineering department early in the design of its huge Appliance Park, Louisville.

Although the available water supply from the Ohio River was a favorable factor when the plant location was selected, it was recognized that the expected daily water usage of better than 25 million gal could cost GE in the neighborhood of this tremendous sum.

While the site provided excellent ground conditions for the construction of this "industrial city," underground water supply, unfortunately, was not available. Looking ahead, the problems of rising water costs and

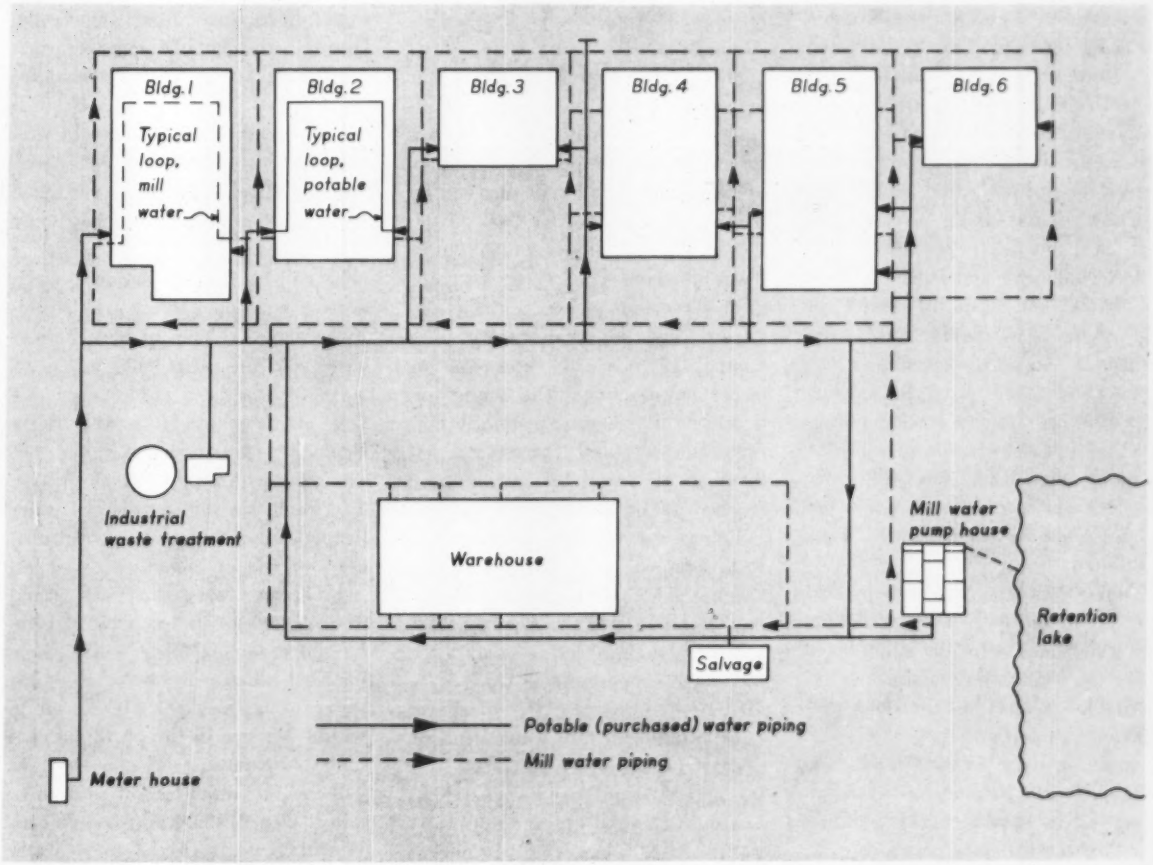
Water, a basic and vital utility in the metal working industries, can cost the big user a lot of money. During summer peak usage, General Electric's Appliance Park uses more than 25 million gal per day, but buys only about 25 percent of it—the rest being stored outdoors and re-used after treatment via an internal "mill water" piping system. The result: a $500,000 annual saving in water costs.

the need for water conservation loomed as important criteria in planning for the company's plant productivity and profitability objectives.

A breakdown of usage requirements between potable water and "recycle" or process water, coupled with the fact that about 50 million gal of storm water runoff could be expected with each 4 in. rainfall, gave the design engineers the bases for a unique system layout. Its purpose: to re-use as much process water as possible, at the same time buying only enough potable water from the city to meet domestic and makeup water needs.

The installed system includes a 30 in. purchased water line extended from the Louisville water utility to a meter house at the northwest corner of the site. This line delivers potable water at about 60 psi and has capacity to meet the total water usage requirements for the Park.

A single underground 24 in. cast iron primary line, reducing in size



WATER IS DISTRIBUTED via two separate primary piping systems: potable (purchased) and mill. Lines parallel each other inside buildings, along with other utility services. Both systems dump into common sewer lines back to pumping station. Water unfit for recirculation is conveyed to industrial waste treatment plant

at takeoff points, connects the meter house with internal service loops in all buildings. From the buildings' internal riser points, one at each side of major buildings, 8 in. steel piping completes the distribution system, providing for convenient branch runouts at desired locations.

Actually, only about 25 percent of the water used daily is purchased water. The remaining 75 percent, reaching a peak summer 20 million gal per day, is provided by an internal closed-circuit "mill water" system.

This in-plant system is a combination fire protection and process water source which takes storm water from the large building roofs and landscaped areas for makeup. The return line of the closed-circuit system is the storm water piping system, thus eliminating an initial investment of $500,000 or more for return piping.

The system begins at the mill water pumping station and is installed as a complete loop circuit, both for the entire Park area and around each building. This arrangement was used because of the complete coverage required for fire protection.

Underground piping is cast iron, bell and spigot type, starting with a 24 in. diameter and reducing to 18 in., 16 in., and 12 in. as takeoff requirements allow. In addition to the numerous standard sprinkler, hydrant, and stand pipe riser points and extended systems, each building has an 8 in. steel pipe loop which parallels the 8 in. domestic water loop. Water pressure at points of usage is maintained at about 75 psi minimum.

Other utility services—compressed air, steam, gas, etc.—also parallel the two water lines inside the buildings to serve the branch line facilities as required to connect with various production equipment.

Both primary water systems are equipped with pit-mounted sectionalizing valves so that every building has dual service entry points. Operating experience has shown this arrangement to be very important and rewarding. The internal pipe loop systems also have sectionalizing valves to permit two-way service flow.

Treat, Cool Water for Re-use

The mill water pumping station itself consists of 4 million gal reservoir storage. Here, chemical treatment is provided for pH control, algae removal, and turbidity relief. Service pumps, of the vertical turbine type, comprise seven 400 hp units. Five are electric motor driven and two are diesel engine driven, the latter two being emergency standby units for fire protection. The station includes spray pond cooling facilities for cooling water for re-use.

A storm water retention basin of earth bank construction, with an ultimate storage capacity of about 50 million gal, is presently used for storm water runoff control and long range water conservation experimentation.

Mill water leaves the pumping station at about 140 psi and at a maximum temperature of 84 F. Having completed its equipment cooling or process function, all of it that can be re-used flows by gravity back to the station via the underground storm sewer system. This extensive pipe grid for water pickup is generally vitrified clay pipe for smaller sizes (under 12 in.) and concrete for larger outside lines. The piping increases in diameter according to flow requirements, until the several returns to the reservoir station have reached 72 in.

Return water is spray cooled before it is dumped back into the basins. Cooling is not required during winter months because of the weather effect on basin surface and ground when the water temperature is from 50 to 70 F.

In addition to rain water makeup, domestic water which has been used in "once-through" process operations is also discharged into the mill water return. Also, engineering planning is under way for additional recovery of certain constituents from the industrial waste treatment plant for makeup use.

During the past few years Appliance Park has reached its completed construction stage insofar as current plans are concerned. In that time the mill water system has provided excellent water availability, and at a unit cost of less than half the cost for delivered domestic water.

Met a Few Operating Problems

While these results provide a very favorable measure of the initial design plan, there were, however, several operating problems which had to be met and should be mentioned:

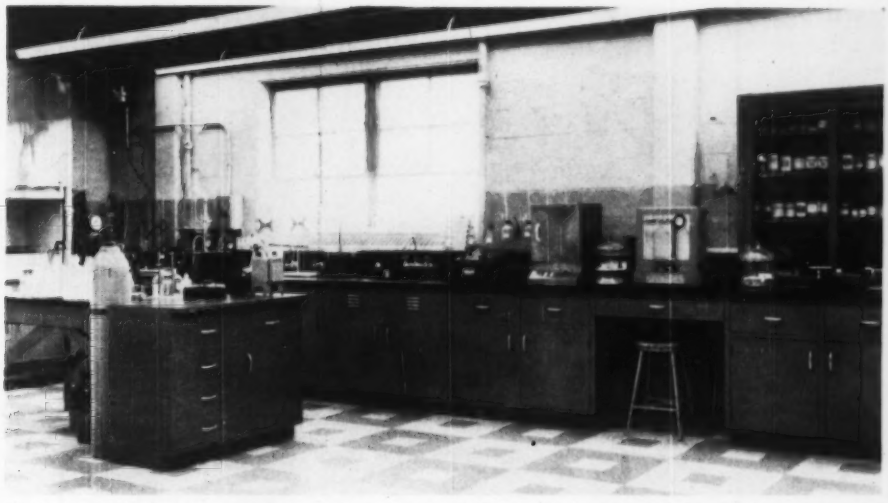
Appliance Park is a heavily landscaped area, with about 100 acres in trees and lawn and the rest of the undeveloped yard area screen planted and grassed. Without this landscaping, mill water turbidity control would have been almost impossible. During early construction stages, each rain storm would result in turbidity in excess of 300 ppm.

The record shows considerable improvement as the landscaping developed. With normal rainfall and good operating control, turbidity maximum is now about 75 ppm. Long range plans call for the installation of clarification equipment to control turbidity to about 50 ppm average limit—acceptable for nonpotable water.

Another problem encountered was that of temperature control. Basin perimeter spray systems could not keep pace with increased water needs. The result was raised delivered water temperature, with the consequent need for greater volume.

It became clear that this could develop into an endless cycle of trouble. So a cooling tower will soon be installed which will enable hot return water to be mechanically cooled to within 7 F deg of the prevailing wet bulb temperature, or about 80 F, without the obstacles of wind loss, low efficiency, and control problems. It will thus provide a good water temperature range.

It is estimated that, when these additional facilities are all in place,



IN INDUSTRIAL waste treatment lab, water unfit for re-use is constantly sampled, tested for treatment to make sure it is acceptable for disposal into city sewers. Recorder panel (not shown) gives visual condition of water being chemically treated. GE is studying possibility of recovering some of this water to further reduce its purchased water costs

the mill water cost will increase by about 2c per thousand gal. However, the unit cost of delivered water will still offer excellent economy when compared to the alternate of domestic water use.

Real Success Lies in Operation

The real success of the Appliance Park water program probably lies in the overall method of operation. Supervised and operated by the boiler house and utilities component of the park's relations and utilities plant facilities service section, water is "sold" to the seven individual plants located on the site at a unit price rate. The only exception is an allocated fire protection assessed charge which is divided on a prorated basis according to building size.

The "customer" has the option as to whether to use "once-through" domestic water or the lower cost mill water. The utility service section is therefore definitely on a "profit and loss basis," with all costs of the water system charged into the unit price.

System Cost $2 Million

With a distribution and collection system of some 10 miles of piping, varying from 24 in. down to 8 in. in diameter, and about 16 miles of combination storm water and mill return sewers, we are talking about a water plant with a capital investment of about $2 million.

Present annual operating costs for the mill water plant will be in the vicinity of $400,000 while pumping a total of 5 billion gal. The pumping station operates automatically and the only labor involved is for surveillance checking several times a day and for routine maintenance.

Other features contributing to the success of the system are the methods used to control the quality of the water. Mill water is treated for corrosion and scale prevention and to prevent growth of organic material. A fast film forming polyphosphate is used for this purpose. The pH of the water is adjusted by use of spent anodizing acid recovered from manufacturing areas. Sterilization is accomplished by chlorine treatment. Copper sulfate is also dissolved in the spray pump suction bay during hot weather.

Water treatment costs come to about $20,000 per year. Labor and chemical enginering service for this treatment is supplied by the Park's industrial waste treatment service component on an internal work order basis.

Service Interruptions Few

Service interruptions over the past five years or so have been few. In almost every instance where a pipe line break did occur, it was caused by either a defective underground section (evidenced by horizontal pipe split) or by ground shift of the pipe line proper. Other than the few line breaks encountered, the system has been trouble-free.

GE justifies this mammoth activity on the bases of low unit cost of water, reasonable quality, and an end product savings to the Park in excess of $500,000 each year as measured against the cost that would have been incurred had puchased water satisfied equal requirements.

In the years ahead more attention is certain to be focused on water conservation. Rising costs will continue to require greater emphasis on productivity and profitability throughout the industrial world to the point that water—in the past, an insignificant utility—can become a very important contributor to long range successful plant operations.

Appliance Park has a very large internal water system. But the principle under which it operates can be used in smaller plants as well, both to cut water costs and to conserve this basic and vital utility. ≠

How to Design Controlled Environment For Best Greenhouse Growing Conditions

Here's a year 'round steam heating and evaporative cooling setup whose operating success is proved by delivery of more and better salable flowers and plants

BY LEWIS SMITH
Heating Engineer

MAN is blessed with the facility to voice disapproval if his environment is too hot or too cold. It doesn't always do him any good, but at least he can make himself heard. Plant life, on the other hand, must fail or flourish quietly, relying on the whims of Mother Nature.

But when these plants take on economic value, such as in a commercial greenhouse, then man does step in to create the temperature, humidity, and lighting conditions which will produce optimum growth to bring top prices on the open market.

Such is the enterprise carried on by the Pierson greenhouses at Cromwell, Conn. This largest establishment of its kind in the U.S. under a single ownership comprises an area under glass of 1,350,000 sq ft (about 31 acres) — the equivalent floor space of a large office building.

Air conditioning, 24 hours a day the year 'round and with a greater degree of accuracy and flexibility than is ordinarly required in other commercial structures, is an absolute necessity. If not provided, the result will be inferior flowers which can only be sold at a low price, if sold at all.

In greenhouses there is no "comfort zone" such as is designed for buildings intended for human occupancy. Each plant needs its own climate for best results. To make matters still more complicated, different plants may be grown in successive seasons requiring different climates within a single greenhouse. Thus there is no one formula by which the heating and air conditioning can be calculated, designed, and installed for continuous use under uniform and predictable conditions.

Breakdown Could Be Disastrous

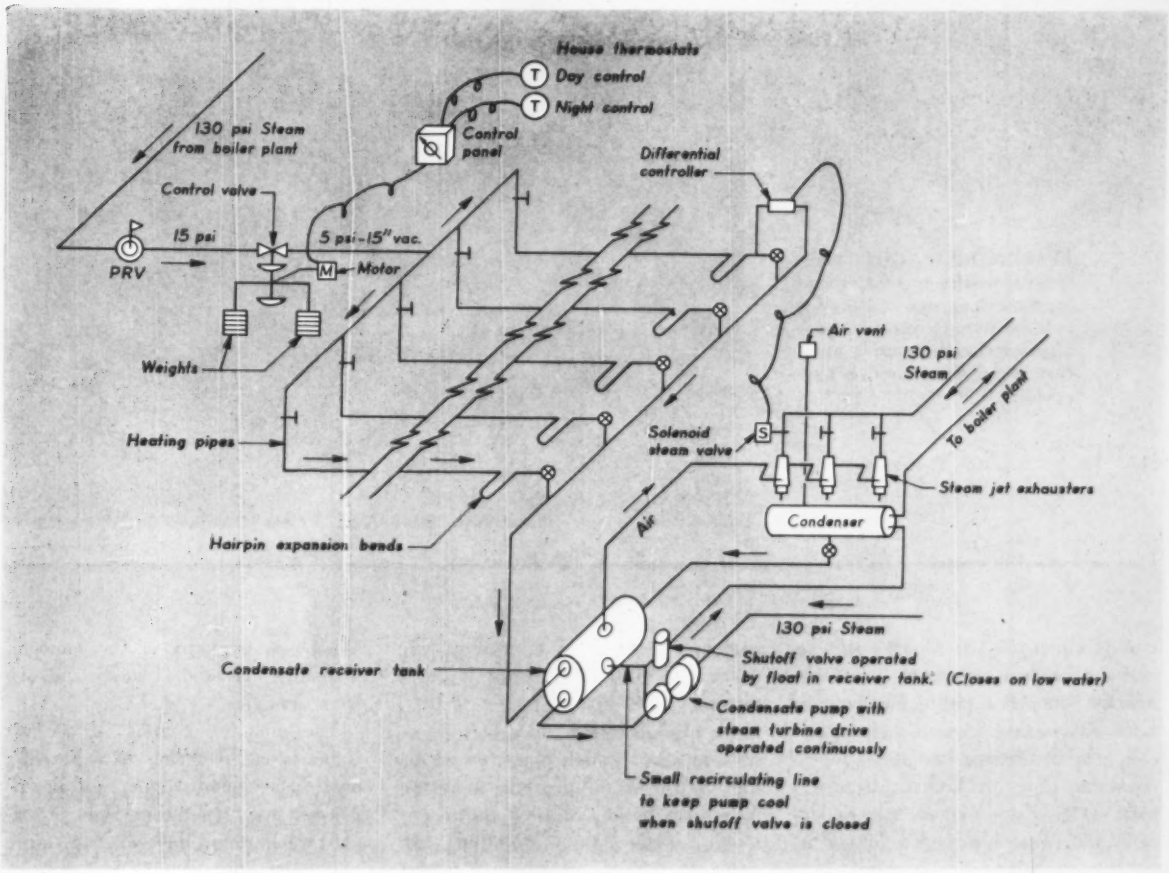
A breakdown of the heating plant could be a disaster. The boiler plant at Pierson's is designed to take care of every contingency. It houses seven water tube boilers with forced and induced draft fans. Working pressure is 150 psig.

Two boilers are oil fired and four are stoker fired, each capable of generating 27,600 lb of steam per hr. The seventh boiler can be fired with either oil or pulverized coal and can generate 50,000 lb of steam per hr. This unit was designed for 400 psig, with the idea that in the future a steam turbine might be installed which would deliver 150 psig exhaust steam into the heating system after generating all the electric power required for the property.

Although the total capacity of the boiler plant adds up to 215,000 lb of steam per hr, the present peak demand has been only 135,000. Therefore two boilers are kept in reserve.

As added insurance against breakdown, fuel supply is assured by the use of both coal and oil, with adequate storage of each. The annual fuel consumption runs about 5000 tons of coal and 70,000 bbls of No. 6 oil (2,940,000 gal). In addition to the greenhouses, steam is also supplied to 27 apartments occupied by employees of the firm.

Coal is received in trucks, passed through crushers, hoisted to the top of a 600 ton silo, fed out at the bot-



GREENHOUSE HEATING requires considerable valve manipulation to keep right amount of steam in lines during mild weather. Weights on valve levers are shifted by operating personnel so that vacuum exists at times. Steam jets are used to produce a vacuum in receiver to achieve reduced steam temperature, good distribution

tom of the silo by a conveyor to a scale, and then delivered to the stoker hoppers. A pulverizing mill serves the one large boiler as required.

A 100 kw steam turbine generator set is held in reserve to run all electrically driven boiler room accessories and most of the refrigeration compressors around the property in case of a failure of the purchased power. The total connected load is about 450 kw, but more than half of this is for flood lighting for which no provision is made for power failure since lack of lighting would only retard and not damage the plants.

Distribute 150 Psig Steam

Steam is distributed by overhead mains at 150 psig. Return mains are mostly underground and come back to the boiler plant by gravity. The only exception is a new section which is at a lower elevation requiring a pumped return.

Condensate is handled two ways:

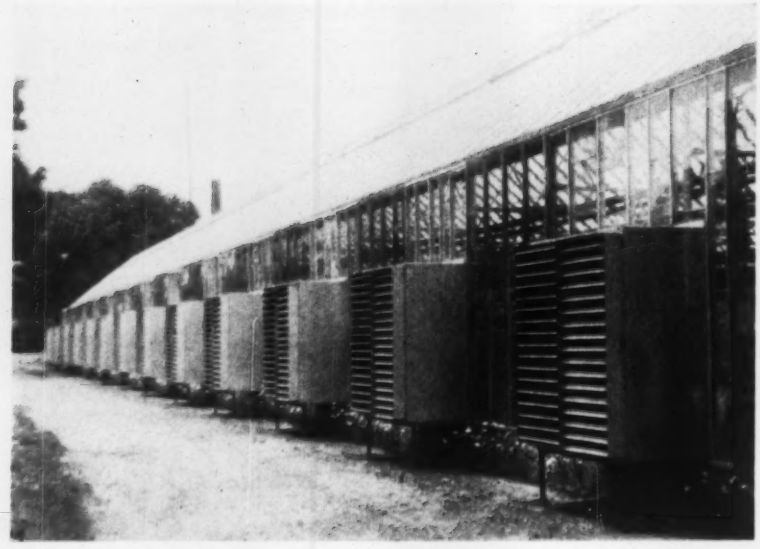
1) In cold weather, when steam at pressure is required for heating, the returns come back to a receiver from which the condensate is pumped through a deaerating heater to a hot well. From the well it is picked up by boiler feed pumps, two of which are driven by steam turbines and the third by an electric motor. Since some steam is used for purposes other than heating (and its condensate is wasted), makeup is about 10 percent. This water is properly treated.

2) In mild weather a vacuum is maintained throughout the heating system (for reason which will be explained later). The heating returns are then switched to a different receiver from which the air can be removed at a vacuum by several steam jets. The number of jets in use is manually adjusted to keep vacuum of about 15 in. Hg. The condensate is removed and pumped to the hot well by a steam turbine driven centrifugal pump.

Compensate for Expansion

For heating the greenhouses, 2 in. pipes have been laid along the ground next to the flower beds. Some of these pipes are nearly 500 ft long, but are so well graded with the flow that there are no pockets to hold up water and cause water hammer or erratic circulation.

These pipes are anchored in the middle so that the expansion at each



EVAPORATIVE COOLING system includes encased propeller fans along one wall which pull air through greenhouse at high velocity, evaporating water from aspen wood fiber pads on opposite wall

end is about 2½ in. On the supply end the headers are about 8 ft high and the connecting piping has enough flexibility to take care of this expansion. On the return end these pipes terminate in a trench close to the return mains. Here, 5 ft hairpin bends of ¾ in. pipe have been found to last almost indefinitely and take up the full expansion without damaging the trap bodies.

Basic Control Is Manual

The basic temperature control is manual, supplemented by an automatic control. Steam is delivered to the various houses at 125 to 140 psi and is first reduced to 15 to 18 psi through dead end reducing valves. The second reduction is accomplished by a double-seated, double-diaphragm, weight operated reducing valve with a v-notched sleeve to give steam flow in direct proportion to the valve opening.

In cold weather the reduction is to 2 to 5 psi. These valves are fitted with proportioning motors which are arranged to shift the fulcrum of the weight arm. A potentiometer thermostat in the greenhouse controls this motor for the amount of steam required, and acts as a high limit control. Employees working in the houses during the day and the night patrolmen turn steam on or off, as required, according to the recording thermometers.

In mild weather, however, it is hard to keep enough pipes turned on and keep them full of steam to assure even distribution of heat the whole length of these long buildings. At such times the employees shift the weights on the valve levers so that a vacuum appears in the pipes. At the same time the operator in the boiler plant cuts in the receiver with the steam jets. The result is that the temperature of the steam in the pipes is reduced from 218 F (or more) down to around 180 F and the volume of the steam expands greatly so that not only can more pipes be kept on but they will be full of steam to the trap, insuring good distribution.

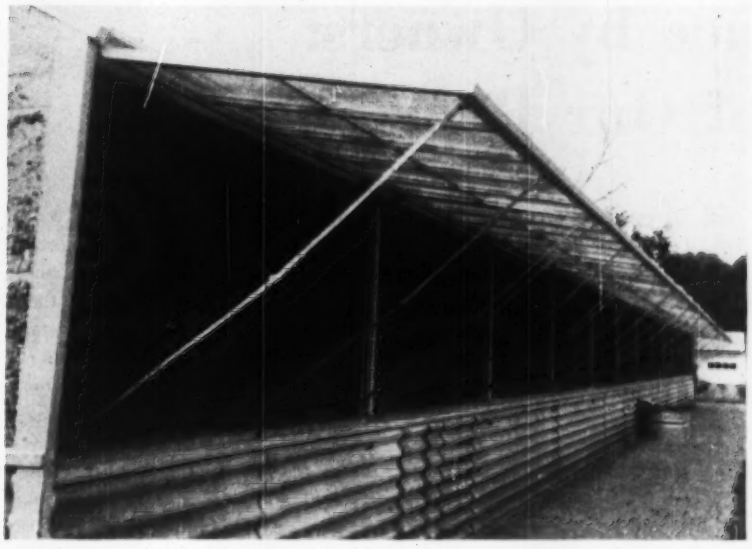
This operation requires a good deal of valve manipulation. In the new section, which has its own vacuum pump, experiments are being conducted to achieve more automatic control. A device has been installed which is actuated by the difference in pressure or vacuum between the steam in the heating pipes and in the return lines. If the differential needed for full circulation drops too low, this device electrically opens the steam valve to one of the three steam jets attached to the condensate receiver to build up the vacuum. The other two jets are, at the moment, manually operated. Usually the one jet is enough.

The moisture content of the air is increased by means of vaporizing nozzles in small copper pipes suspended over the flower beds. A triplex water pump develops a pressure of 600 psi to vaporize 1.3 gph per nozzle into a dense fog. The pumps are controlled by humidistats and are entirely automatic. Proper humidity in the rose houses, for example, increases the number of buds and improves the quality.

Combat Solar Heat Gain

Cooling is a fairly recent addition to climate control in greenhouses. Excessive summer heat is damaging to almost all flowers. The ideal temperature ranges from 50 to 72 F, but such an ideal is practically impossible to attain without some kind of cooling. From 72 to 90 F the plants begin to suffer to an increasing extent. Above 90 F all flowers are definitely inferior.

Due to the solar heat gain, greenhouse temperatures will range from 95 to 115 F as normal maximum peaks and will go even higher at times in some locations. Obviously, mechanical refrigeration could be used, but both the first and the op-



ASPEN WOOD FIBER PADS, 2 in. thick, on wall opposite from fans, serve as wet screens through which air is drawn. Water is kept circulating by small sump pump

erating costs would be out of proportion to the benefits.

Cool by Evaporation

It has been found that the evaporation of water can be made sufficiently effective in most locations to produce a very desirable improvement in the crop at a relatively low cost. Of course, the extent of this benefit depends entirely on the wet bulb temperatures in the locality and may vary greatly from year to year. But even so, the added revenue has in some cases paid for such an installation in the first year.

After several years' experimentation in the Southwest, with its dry climate but intense sun, a system has been developed which is now being used with such good results, even in the more humid climates, that Pierson's has made extensive use of it. The idea is basically very simple: pass enough air through a wet screen and pull it through the greenhouse at the maximum velocity the plants will stand without injury.

The actual installation in one large greenhouse at Pierson's will illustrate the problem and the solution. This is a house 455 ft long × 81 ft wide. Mounted along one side wall in weatherproof casings with automatic shutters are 22 six-bladed fans 42 in. in diameter. These fans are rated to handle 14,200 cfm at 0.1 in. water gage static pressure, which is the pressure drop through the pads or screens when wet. Each fan runs at 400 rpm, belt driven from a ¾ hp. three-phase motor.

On the opposite wall are mounted 158 pads which are 34 in. wide × 66 in. high × 2 in. thick and filled with aspen wood fiber. They are installed in a variety of ways according to the construction of each greenhouse so that they can be covered in winter or replaced with glass sections.

A trough or perforated pipe is used to supply water at the tops of the pads. This water is collected in a gutter below which is graded to a small sump pump which recirculates the water with means for adding makeup and for draining off sufficient quantity to keep impurities from getting too concentrated. At least 1/3 gpm is required per linear foot of pad, regardless of height, so that in this case a total of 153 gpm is needed, plus some 3 percent or more for loss by evaporation.

With all the fans running, the total air moved is 312,400 cfm passing through the greenhouse from one side to the other. This is about 8½ cfm per sq ft of ground area. There is, of course, some leakage, so not all of this air enters through the pads. But neglecting that factor, the velocity through the pads is about 123 fpm.

Two years' experience reveals that the greenhouse temperature can be kept within the 90 F maximum and at much lower temperatures on the average. This can be expected as long as the outdoor wet bulb temperature stays within normal limits for the locality. The summer of 1957 was about normal in this respect and the installation was practically paid for out of increased volume and profits. The 1958 summer was abnormally humid and the results were not nearly so good.

In drier climates the temperatures in greenhouses cooled in this way may be 20 to 30 F deg below those in an uncooled house. As a side issue it is reported that some plant insects reproduce at a far lower rate, are less active, and don't live as long as they would under uncooled conditions.

Perhaps some day artificial light will be developed at a practical cost to duplicate sunlight in its effect on plants and flowers. Then it may be possible to have greenhouses with insulated roofs instead of glass roofs which will bring about a fabulous saving in both heating and cooling costs with even better flowers at an improved production rate. ✣

Photos courtesy Acme Engineering & Mfg. Corp.

Poor Maintenance by Owners: The Bane of Our Reputations

A client's failure to maintain his heating and air conditioning system properly can cast a bad light on the professional standings of the engineer, contractor, and equipment manufacturer alike. On the job, let's drive home the importance of regular servicing of equipment. So says a consulting engineer, author of this article, who wishes to have his name withheld.

WHEN a mechanical installation goes on the blink, very often the reputations of several — of the consulting engineer who designed it, the contractor who installed it, and the manufacturer whose equipment comprises it — are at the mercy of its owner. Almost always, however, the blame really lies with the owner. For it has been his disregard for proper maintenance that has caused the failure in the first place.

This situation is well illustrated by a large company with 50 branch offices throughout one of our western states. Of these 50 branches about 25 were built in the past seven years. These new installations have been an almost constant nightmare to the consulting engineer who designed them *because the client does not provide any personnel to maintain and operate the equipment.*

In each of the branch offices a busy manager is saddled with the job of keeping tabs on the boiler, the fan system, the refrigeration equipment, the time switches, the temperature control system, the "draft complaint department," and the hundreds of little things like cleaning filters, oiling motors, and checking to see that systems are functioning efficiently.

As you have guessed, he looks at nothing short of a catastrophe. He is far too busy with the real problems at hand — conducting a complicated business operation. As a result, little things which keep a heating and air conditioning system operating properly are not taken care of. Ultimately, satisfactory operation ceases.

At about this time, a loud scream is heard at the main office by two other busy executives, who also double as building trouble shooters, that the heating and air conditioning system is "no good."

The two home office executives, not knowing for sure what an air conditioning system is, howl bloody murder at the engineer who designed the monstrosity. After an ear-burning phone call, the latter makes his monthly trek to survey the situation and patiently writes *another* report recommending that someone be delegated to maintain and operate the system.

What can happen to an installation where no thought is given to operation and maintenance? A typical situation is a three-year-old, million dollar branch office of this same company. The system is actuated automatically by preset timers and is supposedly looked after by the operations manager — who also has the work of 15 clerks and 30 bookkeepers to oversee. At the last query, he had not yet read the operating instructions which had been furnished him *two years previously.*

Under constant nagging, the operations manager finally agreed to hire a filter cleaning service company to clean the air filters and to oil the motors. That is the sum total of maintenance and operation being given to the equipment.

On a particularly warm day this past summer, the following faulty maintenance items became apparent:

1) Kitchen and toilet exhaust fans failed to function because birdscreen outlets were clogged.

2) The air conditioning system was unable to keep the main area cool because the belt drive on the supply fan was slipping badly and the chilled water temperature control was out of adjustment. Also, the heater circuit for the chiller kicked out on overload because the exhaust fan was shut off at the main panel and because the steam converter was left running, which helped to overheat the mechanical room.

3) The second floor air conditioning system failed to cool that area because the filters were clogged.

4) Water ran over the top of the drain pan for the main office unit air conditioner and spread all over the fan room because condensation drain outlets were plugged.

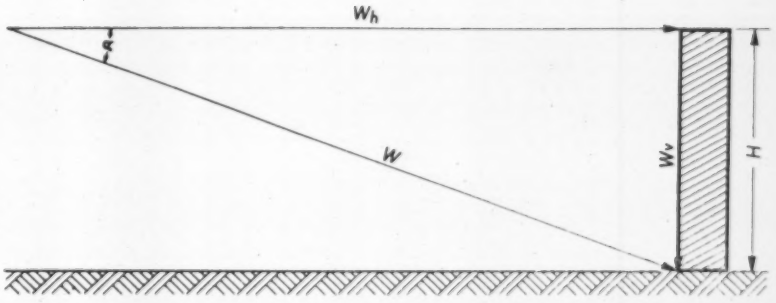
5) The conference room became too cold because the damper linkage had become disconnected at the multizone unit.

6) The exhaust fan wasn't working because the timer was off schedule.

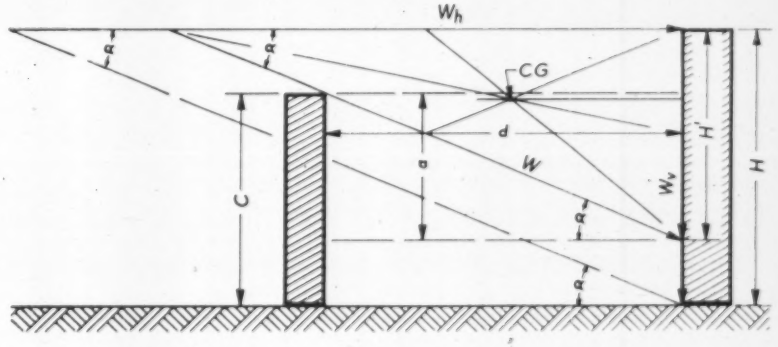
This sort of thing had been happening for two years. As is almost always the case, the failure of the system to perform was assumed by the client to be a design discrepancy. The engineer's report was, at best, treated as a set of "excuses."

The contractor who installed the chiller and the manufacturer who made it also came in for their rounds of criticism.

Yes, the reputations of the consulting engineer, contractor, and manufacturer are definitely at the mercy of owners who do not properly maintain and operate their equipment. It should be impressed on clients the importance of servicing their own equipment; that — no matter how high the quality of the equipment may be, how expertly it is designed and how well it is installed — it will ultimately bog down unless cared for through good, sound maintenance procedures. ∓



1 RELATIONSHIP of horizontal and vertical components of effect of wind on a building is depicted here, where H is building height, W is wind direction, α is angle to ground, W_h is wind horizontal component, W_v is wind vertical component



2 EFFECT OF INFILTRATION can be calculated for a given building of height H at a distance d from nearest building with height C by using method suggested here

Here's How to Figure Infiltration Due to Stack Effect

. . . *when calculating building heat loads*

BY RALPH J. ABRAMSON
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How much should a heating engineer add to the design load for a building to account for infiltration resulting from stack effect? Here's a new approach to figuring this.

The average angle of wind direction with the ground at any point on the earth's surface will depend on the slope of either the cold or warm front caused by atmospheric conditions. Cold front slopes are normally the more steeply inclined. Warm fronts, on the other hand, more generally approach at a shallow angle with the earth's surface.

Air masses passing over a terrain will conform with the general law of fluid wave motion. The ground and the structures on it will resist the lower portion of the air mass and permit the higher portion to accelerate. This creates a tumbling effect much like ocean waves breaking on a beach. When this occurs the slope of the front is changed more radically downward. To date we have no mathematical correlation for this resistance effect.

Some rules of thumb have come from the old sailing days. It was noted that a sail on the windward side of a vessel would cause a "wind shadow" of three to seven times its vertical section (roughly triangular). It is interesting to note that the wind angles with relation to the earth's surface can vary as little as one-tenth of a degree to as much as 30 degrees.

If we draw a building *H* high, and at the same time draw the wind vector, we can resolve the wind vector to a horizontal component and a vertical component. However, if we were to calculate the centroid of the wind force triangle in relation to the centroid of the vertical plane surface of the building, we can see that the combined centroid of the two figures will be slightly above the center of gravity for the vertical plane surface.

It can be assumed that the horizontal component of

the wind force will act on the centroid of the structure. In Fig. 1 the building and wind force triangle are indicated as follows:

H = building height
W = wind direction
α = angle to ground
W_h = wind horizontal component
W_v = wind vertical component.

Chapter 11 of the 1958 ASHAE Guide and Table 2 contained therein give this equation:

$$V_e = B\sqrt{h\ (T_i - T_o)} \quad \ldots\ldots [1]$$

Where:

B = derived value
V_e = equivalent wind velocity, mph
h = floor height, ft
T_i = inside temperature, F
T_o = outside temperature, F.

Converting Equation 1:

(mph × 5280/60) = 88 × mph = velocity (fpm) = V_1
$88\ V_e = V_1$

Then

$$V_1 = 88\ V_e\ B\sqrt{h\ (T_i - T_o)} \quad \ldots\ldots [2]$$

From Chapter 11, Table 2 of the Guide is derived Equation 3:

$$v_1 = Q/A = K\sqrt{H\ (T_i - T_o)} \quad \ldots\ldots [3]$$

Where:

v_1 = stack velocity of air caused by temperature difference.
Q = air flow rate, cfm

At the point within the building where the horizontal wind velocity pressure W_h equals the velocity pressure due to stack effect, we can equate:

$$P_i = P_w \quad \ldots\ldots [4]$$

Where:

P_i = stack velocity pressure, in. water gage
P_w = horizontal wind velocity pressure due to W_h, in. WG.

$$P_i = (v_1/4005)^2 = [K\ [\sqrt{h\ (T_i - T_o)}/4005]]^2 \quad \ldots\ldots [5]$$

$$Q = E \times A \times 88\ V_e \quad \ldots\ldots [6]$$

Where:

E = effectiveness of openings.

$$Q/A = E \times 88V_e$$

$$P_w = (88 \times E \times V_e/4005)^2 = [88\ BE\ [\sqrt{h\ (T_i - T_o)}/4005]]^2 \quad \ldots\ldots [7]$$

But E varies as W_h:—

$\cos \alpha = W_h/W$
$W_h = W \cos \alpha$
$E \approx \cos \alpha$

$$P_w = (88 \cos \alpha\ V_e/4005)^2$$

$$= [88 \cos \alpha\ B\ [\sqrt{(T_i - T_o)\ h}/4005]]^2 \quad \ldots\ldots [6_a]$$

Converting Equation 5 equal to Equation 6_a and $H = sh$:—

$$[K\sqrt{s}\sqrt{(T_i - T_o)\ h}/4005]^2 = [88 \cos \alpha\ B\ [\sqrt{(T - T_o)\ h}/4005]]^2 \quad \ldots\ldots [6_b]$$

$$K\sqrt{s} = 88 \cos \alpha\ B \quad \ldots\ldots [7]$$

At the point of equal pressure on the building wall, the vertical component W_v will be the main force inducing leakage through that floor opening. Therefore:

$W_v = W \sin \alpha$
$B \approx \sin \alpha$
$K\sqrt{s} = 88 \cos \alpha \sin \alpha.$

But $\cos \alpha \sin \alpha$ for small angles of $\alpha \approx \tan \alpha$ and:

$$K \approx (88 \tan \alpha)/(\sqrt{s}) \quad \ldots\ldots [8]$$

In Chapter 11 of the 1958 Guide we are told that if all vertical openings are sealed and the floor and ceiling are tight, "no allowance need be made for chimney effect." Since this is not practical for the average building, some approach for approximating the neutral point between stack effect and wind must be made.

Equation 8 then gives the approximate value of K, *where*:

s = number of floors in building
K = derived constant at point of equal pressures.

It is possible to provide *sufficient air pressure* to counteract the infiltration of the building below the neutral point, and exfiltration from the building above the neutral point. It is also possible to determine the vertical zoning of a structure by this method, and locate the neutral points for each zone and determine the necessary air pressures to counteract the external wind force involved.

The problem is complicated because most structures are grouped in an area and vary in height. Consider the following case:

Refer to Fig. 2. Assume all floor heights of the buildings to be approximately the same.

In an isolated case of two buildings:

$W_v = H'$
$H = H' + (c - a)$

and

$a/d = \tan \alpha$

or

$a = d \tan \alpha$

Where:

d = distance to highest leeward building, ft.

Since H' and C will vary with the number of stories, then:

$C = h \times s''$
$H = H' + (C - d \tan \alpha)$

or

$s = s' + (s'' - d \tan \alpha)$

and

$$s' = s - s'' + d \tan \alpha \quad \ldots\ldots [9]$$

Where:

s' = number of floors of taller building exposed to W_h
s = total floors in taller building
s'' = total floors in smaller building to leeward
d = distance apart, ft.

This value of s' should be substituted in Equation 9:

$$K\sqrt{s'} = K\sqrt{s - s'' + d \tan \alpha} \quad \ldots\ldots [10]$$

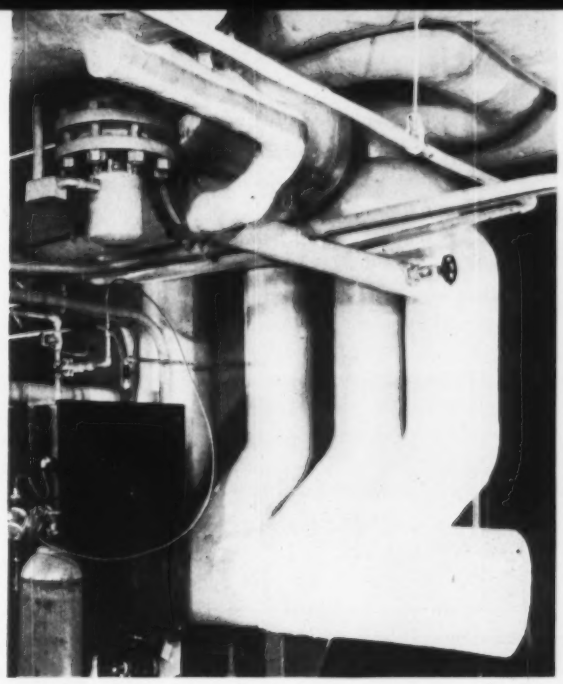
and

$$K = 88 \tan \alpha/\sqrt{s - s'' + d \tan \alpha} \text{ at equal pressures} \quad \ldots\ldots [11]$$

The value of α, or average "frontal slope" of prevailing wind for the period desired, can be obtained from weather bureau data. The average would be about 5 deg in summer, 9 deg in spring and fall, and 14 deg in winter.

Equation 11 will be found useful for most all cases. The value of K is then substituted in Equation 8 and the floor location above grade for equal pressure is determined.

Substitute the value of K from Equation 9 in Equation 5 and substitute the value of s for each floor. Then, a series of pressures will be obtained. The larger values of K (above equal pressures) indicate infiltration and the lesser values of K (below normal pressures) show exfiltration. ⋕



SUCCESS of nuclear reactor plants depends to a great extent on how well its component piping can resist corrosion at high operating temperatures. Designer must judiciously choose piping materials compatible with stiff operating requirements, as was done in piping systems installed at Argonne National Laboratory (right)

How to Avoid Piping Corrosion In Nuclear Reactor Plants

. . . by specifying correct corrosion resistant materials after careful analysis of precise operating conditions to be obtained. This article discusses various methods for designing piping for pressurized water reactors.

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CORROSION RESISTANCE of piping materials used in construction of nuclear reactors is one of the most important factors in successful reactor design and operation. The commercial use of nuclear energy for power has necessitated the development of precise information on corrosion behavior of metallic and nonmetallic materials in a number of media such as liquid metals, molten salts, and high purity water.

In pressurized water reactor systems — used in several commercial power plants now under construction — the principal parts of the primary section are: (1) a pressurized vessel containing reactor core and associated control mechanisms; (2) a closed circuit piping system containing primary water; (3) heat exchangers where the reactor heat is transferred to secondary boiler water to generate steam; (4) pumps to circulate the primary water; (5) pressurizer and surge tanks to maintain pressure on the primary system; (6) a purification system including filter and resin type ion exchanger to continuously remove entrained solids and dissolved ions from a portion of the primary water.

From a corrosion standpoint, the filter and ion exchanger are extremely important parts of the system in that they can remove both soluble and insoluble corrosion products and may thus permit the use of materials for reactor parts having somewhat higher corrosion rates or neutron capture cross section than could otherwise be tolerated.

High purity deionized water with an electrical resistance in the neighborhood of 1 million ohms per cm is used in the primary system. It may be deaerated before use, but not necessarily. It is circulated at a temperature of 500 to 550 F, and the system is pressurized to about 2000 psig to prevent boiling.

If there is some nitrogen dissolved in the water, it will

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combine with hydrogen to form ammonia if hydrogen is present in excess, or may combine to form some nitric acid if dissolved oxygen is present in excess. This will influence the pH of the solution.

In conventional boiler plant systems handling high purity water at temperatures up to 600 F, corrosion normally is kept at a satisfactory level by deaeration and by pH control by adding inhibitors. In a radioactive system, a successful inhibitor, besides being thermally stable and effective at 500 to 600 F, must not become appreciably radioactive under neutron bombardment and must not be decomposed to any great extent by reactor irradiation. So far, no inhibitors have been found which are completely resistant to these effects. Lithium hydroxide is the most promising material, although there is some reaction of Li^6 to form H^3 which adds to the radioactivity of the water system. The addition of dissolved hydrogen gas appears to be most effective in suppressing dissociation of water and reducing corrosion.

Use Austenitic Stainless Steel Components

The austenitic stainless steels commonly used for reactor piping and equipment include Types 304, 304L (low carbon), 309, 310, 316, 316L, 321, and 347. All of these alloys have a high degree of resistance to high temperature, high purity water under conditions likely to be encountered in pressurized water reactors as measured by weight loss or accumulation of corrosion product. They have been the subject of a considerable number of test programs in water under a wide variety of conditions including hydrogen and oxygen content, temperature, and velocity. Much of this work has been done with two of the alloys, Type 304 and Type 347.

Corrosion rates of Types 304 and 347 stainless steels — tested under a variety of water conditions with different lots of specimens and different surface treatments at 600 and 680 F — were very low. Hydrogen in the water in amounts up to 3500 cc per liter did not increase the rate of corrosion. Surface finish had little effect, although in some cases the electropolished specimens showed lower corrosion rates, probably due to smaller surface area exposed.

Austenitic stainless steels including Types 304, 316, and 347 are not subject to intergranular attack by high temperature water when sensitized by heating at 1250 F for 2 hr. Types 304 and 316 are sometimes subject to such attack in some other chemical environments due to intergranular carbide precipitation resulting from heats of welding or stress relieving.

This possibility was probably the reason for selecting the columbium stabilized variety, Type 347, for some of the initial pressurized water reactor equipment. It apparently is not necessary.

Unstabilized types such as 304 and 316 can be subject to some intergranular attack during pickling in nitric-hydrofluoric acid solutions if they have been sensitized during some prior heat treatment.

Nitriding of the 300 series stainless steels will substantially decrease their corrosion resistance to whatever depth the nitriding occurs.

Crevice and Stress Corrosion Are Problems

Stainless steels are subject to two other forms of attack: crevice corrosion and stress corrosion cracking.

Crevices may exist in close clearances of moving parts, in tube sheets imperfectly rolled, in flanged connections, in threaded couplings, on the flat bases of springs, and elsewhere. Accelerated attack may sometimes occur in such crevices where oxygen is present in water due to galvanic cells set up by differences in oxygen content inside and outside the crevice. This form of corrosion will accelerate attack inside the crevice and may develop a volume of corrosion product which will cause excessive wear or complete seizure of the components. The effect would probably not be so serious in degassed water or hydrogenated water. However, in oxygen-bearing water the clearance between parts must be at least 5 mils in order to overcome the possibility of seizing.

The effect of water temperature upon crevice corrosion varies. Normally, at 200 F, the extent of contact corrosion amounts to nothing more than a discoloration of the metal without any measurable build-up.

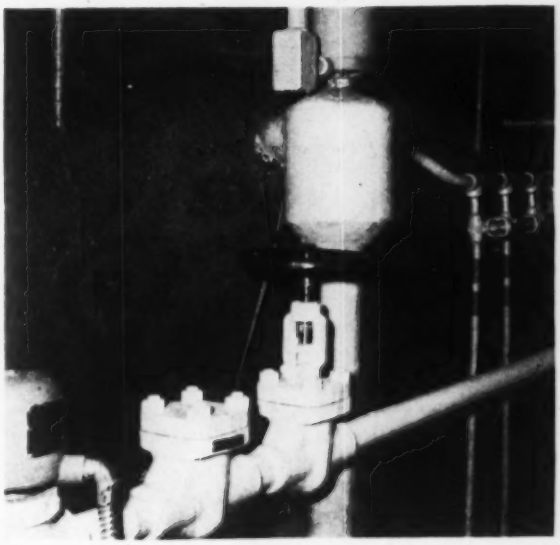
In almost all cases of stress corrosion, cracking of austenitic stainless steels in hot aqueous environments has been detected in the environment, although in some cases in very small amount (as low as a few ppm in the liquid).

In many of the cases involving very small amounts of chloride in the liquid phase, there appears to have been an opportunity for the chlorides to concentrate in some part of the equipment where cracking occurred, such as in the upper part of water deaerator-preheaters in power plants, in crevices between tubes and tube sheets of tubular heat exchangers, and in areas which may be alternately wet and dry.

It does not seem possible to place any safe limit upon the allowable chloride content of the water if operating conditions are suitable for the chlorides to concentrate. Likewise, it has not been possible to place any safe limit upon the maximum amount of measured stress in the alloy. Many of the failures have occurred where stresses were near the yield point of the alloy as in cold rolled, drawn, or bent material. It is generally agreed that fabrication or forming stresses are more likely to cause trouble than stresses resulting from operating pressures. While plastic strain seems an important factor, it is probably not possible to measure the amount of plastic strain which exists in all parts of a piece of cold worked stainless.

The reaction causing stress corrosion cracking may be electrolytic in nature since it can be prevented by cathodic protection from a metal that is anodic to the stainless steel.

In another series of tests, Type 304 stainless samples which had been cold worked, annealed, and stressed did crack in oxygen-bearing water at 600 F. At the same time, samples not cold worked prior to annealing and



SOME FACTORS to consider in designing for corrosion resistance in nuclear power systems are characteristics of piping materials, operating temperature of system, chemical composition of liquid to be piped

stressing did not crack. No cracking occurred in hydrogenated water. It was concluded that stress corrosion cracking probably can be avoided in the reactor itself if mill annealed materials are used.

Thermal stresses set up adjacent to welds of heavy plate have been sufficient to cause stress corrosion cracking of stainless steels in some chloride bearing environments so that stress relief anneal of welded pressure vessels seems worthwhile. Stainless springs would not be used because they are purposely cold worked to obtain necessary spring properties.

The possibility of stress corrosion cracking of austenitic stainless steels in secondary steam-water environments in power plants is a considerably more critical problem mainly because of the chlorides which can sometimes be encountered in steam generation systems — especially naval boilers — or may leak in from cooling or condensing waters. Numerous tests have shown cracking in chloride-containing boiler waters when exposed in vapor or splash zones. In two cases failure of test exchangers has been reported.

Oxygen is a strong accelerator of stress corrosion of austenitic stainless steels in hot water environments. Evidence seems to indicate that some oxygen is necessary for stress corrosion to occur. The necessary amount is small and indicates a possible relationship between chloride and oxygen content in alkaline phosphate treated boiler water. Also, this shows a susceptibility to stress corrosion cracking of austenitic stainless steel exposed to the steam phase with intermittent wetting.

The use of austenitic stainless steels in the construction of tubular heat exchangers transferring heat from primary coolants to secondary boiler water should be subject to a very close scrutiny from the standpoint of possible stress cracking from the boiler water side. If it cannot be assured that the equipment is suitably stress relieved before installation and not likely to develop unsatisfactory thermal expansion stresses in service, it may be prudent to consider the use of material for such equipment which is not subject to stress corrosion cracking in the presence of chlorides.

Corrosion Resistance Varies

The precipitation hardening stainless steels of the austenitic or essentially austenitic types show good resistance to oxygenated water at both low and high velocities. In degassed or hydrogenated water, however, corrosion rates are considerably higher. Limited tests of precipitation hardened stainless steels indicate a susceptibility to stress corrosion similar to, and perhaps greater than, the austenitic stainless steels.

The martensitic (hardenable) grades, including Types 410, 420, and 440C, containing up to 2½ percent nickel and 12 to 17 percent chromium are not as resistant as the 300 series stainless steels. Corrosion rates are high enough that they probably would have only limited use in nuclear water systems. Corrosion resistance of the ferritic alloys containing 18 to 30 percent chromium is somewhat better than the martensitic alloys, with the higher chromium alloy 446 being the best, but their resistance is in general not comparable to the austenitic alloys.

Stainless steels of the 400 series are particularly subject to pitting and crevice attack, and this may proceed at a rate as high as 70 mils per yr in oxygen-containing water at temperatures between 200 and 500 F. These alloys are resistant to the specific types of stress corrosion cracking in chloride-containing waters to which the austenitic stainless steels are subject. However, the martensitic steels when hardened to rather high levels are susceptible to cracking by hydrogen embrittlement in environments where hydrogen is present.

Consider Corrosion Attack at High Temperatures

Nickel and the high nickel alloys are subject to attack in oxygen-containing water at 500 F to a greater extent than the austenitic stainless steels. However, in degassed water and particularly in hydrogenated water, they have very good resistance, with relatively low rates at velocities up to at least 30 fps.

Commercial "A" nickel may be subject to intergranular precipitation of graphite in long time exposure at service temperatures above about 600 F, and for many applications involving this temperature or higher, a low carbon variety of nickel is used with maximum carbon content of 0.02 percent. This material is somewhat low in mechanical strength at elevated temperatures so that where a combination of high temperature strength and corrosion resistance is required one of the stronger nickel base alloys may be used.

Nickel Resists Chloride Attack

One of the most significant properties of the high nickel alloys is their complete resistance to stress corrosion cracking in all of the chloride environments which may cause cracking of the austenitic stainless steels. This has been established by many years of laboratory testing and operating experience. Monel is in common use for tubes of boiler feedwater heaters in modern high pressure steam power plants handling water up to 530 F and steam up to 875 F.

Probably one of these alloys would provide a suitable combination of resistance to corrosion and to stress corrosion cracking in the heat exchangers transferring heat from primary coolants to the secondary boiler water in nuclear plants.

Copper and high copper alloys generally show high corrosion rates in oxygen-containing water at 500 F. Under hydrogenated conditions their performance is much better with 70-30 cupro-nickel and some of the cast aluminum bronzes containing 9 to 11 percent aluminum, 3 to 4 percent iron, and 85 to 88 percent copper showing best resistance to attack. This alloy has been used to a considerable extent for tubes of boiler feedwater heaters and for steam condensers in steam power plants. In the latter application it provides resistance to erosion-corrosion effects at the inlet ends of tubes, particularly where sea water is used for cooling.

The high copper alloys would ordinarily not be used in the primary water system because of their corrosion rates and because of a tendency for dissolved copper to plate out on other metal surfaces and perhaps cause accelerated galvanic attack.

Study Use of Carbon, Low Alloy Steels

Considerable attention has been given to the possible use of carbon and low alloy steels for water cooled nuclear reactors because of their low cost. The steels included are A212 and another carbon steel as well as low chromium steels A335P11, and A335P22. A comprehensive series of corrosion tests included over 70 tests with about 1000 test specimens and about 14 water conditions.

The majority of tests reported here were run in circulating loops at 30 fps (high velocity) or at 1 fpm (low velocity). System pressure was approximately 2000 psig for the 500 and 600 F tests. Continuous water purification was provided by bypass circuits including filter and ion exchanger. Water was maintained at a resistivity of approximately 1 million ohms per cm except as reduced by additives for water treatment. Corrosion rates are reported on a descaled basis in order to suitably compare low velocity and high velocity results. Rates reported for a given test condition are in many cases an average of several specimens.

It is apparent that corrosion rates of carbon steel can be high in water of pH 7, even with hydrogen present, so that most attention is given to results under inhibited conditions at around pH 11.

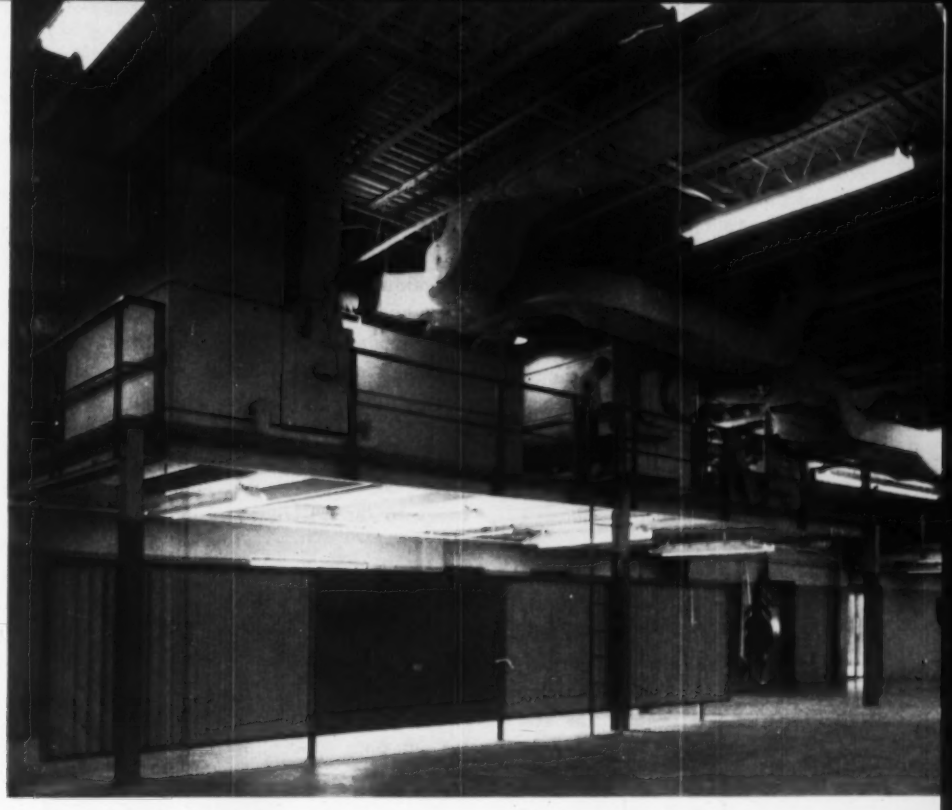
Temperatures from 200 to 750 F were investigated during the work. Little, if any, effect on corrosion was noted between 500 and 650 F. However, a limited number of tests at 750 F indicated that corrosion at this temperature could be five times that at 680 F under some conditions. It was found that corrosion rates decreased with time of testing.

The control of pH is undoubtedly of great importance in the ability of steel to resist corrosion. The inhibiting effect of high pH in the corrosion of steel is by no means a simple matter. Erosion-corrosion tests of carbon steel in distilled water with pH values from 3 to 10 at 120 F showed minimum corrosion rates at pH 6 and pH 10, with a rate at pH 8 more than 10 times that at pH 6. In other tests the erosion-corrosion attack of cast carbon steel at 250 F in boiler water with pH 8.4 was more than twice that at pH 7.6.

Also reported have been several cases of stress corrosion cracking of steel subject to localized stresses in power plant boilers operating at pressures from 850 psig to 1400 psig and using deaerated distilled or deionized water for boiler feed. In these cases the pH of the water in contact with the steel ran from 7.0 to 9.5. The occurrence of stress cracking is attributed to the inability of steel to form a protective film of oxide in water with pH values this low. Performance of steel apparently is much better when the boiler water is chemically treated to have a pH of 10.5 or above.

The limited amount of work done with the low-chromium steels A335P11 and A335P22 indicated that they were somewhat more corrosion resistant than A212 for the condition tested. There was no significant difference between the two chromium alloys.

Thus, carbon steel and some low alloy steels may be considered for use in reactor construction with pressurized water systems, providing that all of the several conditions necessary to their suitable performance can be accurately maintained during reactor operation. It will require considerably more work to determine whether this can be accomplished. ∔



AIR HANDLING UNITS on equipment mezzanine at Kearney, Neb., plant are supplied with chilled water from steam absorption units in boiler room

Actual operating data from two gas air conditioned industrial plants are compiled here to answer the question —

What Does Gas Air Conditioning Cost?

ABSORPTION SYSTEM *and* STEAM TURBINE DRIVEN COMPRESSOR SYSTEM

BY H. CAMPBELL STUCKEMAN
Vice President
Rockwell Mfg. Co.

ENOUGH OPERATING experience has been amassed to definitely prove the worth of complete air conditioning in industrial plants. This is true not only for comfort's sake, but also for production economy and efficiency.

In our own air conditioned plants, we have obtained better quality workmanship through closer temperature control of tools, fixtures, and parts to be machined. Elimination of rusting has made possible inventory and equipment savings. And the use of windowless construction has resulted in (1) an estimated 5 to 10 percent more usable floor space as a result of the elimination of aisles next to windows, (2) better-engineered lighting systems not dependent on outside lighting, and (3) elimination of window maintenance costs.

When we were contemplating complete air conditioning of our production facilities, the advent of readily available natural gas (in most areas) and air conditioning equipment designed to use it led us to install gas systems.

How Should We Use Gas?

Once we decided to use gas in air conditioning a plant, we had to determine *how* to use it. Should the gas be used for firing steam for turbine driven compressors, or should an absorption system be the answer?

We've tried both. Suppose we analyze our Sulphur Springs, Texas, plant as a typical compressor installation and our Kearney, Neb., plant as a typical absorption system:

• Steam Turbine Drive System

The Sulphur Springs plant is primarily a manufacturing center, but it also serves as a warehouse depot and service center. It is a 116,000 sq ft factory area of windowless construction, completely air conditioned by a 425 ton system which employs a steam turbine driven centrifugal compressor.

Circulating pumps carry the water to ceiling suspended blower units. Water temperature is held at approximately 45 F. In cold weather, hot water is circulated through the system for heating. Plant temperature is kept at 76 F and at 50 percent relative humidity.

Two 130 hp locomotive type fire tube boilers, fired by natural gas, supply steam for the compressor turbines.

Gas bills from the plant's operations indicate an average fuel cost of $356.72 per month for a typical three-month cooling season. Based on an eight-hour day, six-day week operating schedule, the gas cost averages about $1.57 per hr of operation. Assuming 1.5 cents per kwhr power cost, the electric energy cost for the system is about $1.00 per hr for operation of fans, pumps, and other electrical equipment.

Assuming the cost of a maintenance man at $2.25 per hr, the total operating cost of the Sulphur Springs plant, including fuel, power, and maintenance, is $4.82 per hr for the 425 ton plant. This represents a unit cost of 1.13 cents per ton per operating hr, not including depreciation and interest expense.

• Absorption System

The plant at Kearney is quite comparable to Sulphur Springs. Fully gas air conditioned, it has a manufacturing area of 150,000 sq ft and an office area of 25,000 sq ft.

The refrigeration system consists of two 485 ton closed-circuit lithium bromide absorption machines using steam at 12 psig for cooling. Estimated load in the plant is 870 tons, with peaks of approximately 950 tons occurring when electric furnaces are in continuous use.

The office area is cooled by a completely separate system using another absorption machine with 265 F hot water as the energy source. This unit develops approximately 103 tons at nominal conditions.

The hot water boiler supplying energy to the office absorption unit for summer cooling serves a dual purpose: It is interconnected to supply 180 F hot water to the office air conditioning units for winter heating, and the same piping is used for chilled and hot water.

Bids were taken for this installation on both absorption units and steam-driven centrifugal equipment.

Bids received resulted in equipment costs of approximately $100 per ton for both types. The bids involved the refrigeration machines specifically, but did not include accessories, except for surface condensers in the case of the turbines.

The cost for boilers and accessories for absorption units is less than that required for turbines which must operate at higher steam pressures in order to develop reasonable water rates. Operating characteristics of absorption units under varying loads are also favorable.

Under 70 percent load conditions, the absorption system steam consumption in terms of pounds of steam per ton of refrigeration increases 15 percent above full load rate. Figures on a multi-stage condensing turbine indicate an almost 50 percent increase in steam consumption under these conditions. The difference in steam (water) consumption becomes even greater as the load drops below 70 percent.

Other factors to be compared between the two systems were cost of maintenance personnel and cost of maintenance parts and materials.

It was the considered opinion of the consulting engineer that there was no significant distinction costwise between them.

The overall cost of operation was computed. Average cost of gas, supplied by the gas utility, is 26 cents per 1000 cu ft. Gas, at 26 cents, produces steam at about 32 cents per 1000 lb of steam for fuel. This results in a fuel cost of approximately 58 cents per hr per 100 tons of refrigeration; or, for the 870 ton load, the fuel cost is approximately $5.05 per hr.

The average cost of electric energy at the plant is approximately 1.25 cents per kwhr, based on a total plant load of 1000 kw demand and 313,000 kwhr usage per month. Electric energy required for the boilers, pumps, cooling tower fans, and other electrical accessories for the cooling system is approximately 140 kw per hr and costs about $1.75 per hr based on the average energy cost.

Interest and depreciation costs, based on charging off one-half the cost of the boiler plant and the total cost of the absorption units and accessories over a 20-year period, equals approximately 75 cents per hr of operation, based on 2240 operating hr per season.

Cost of a maintenance mechanic for the air conditioning equipment is approximately $2.25 per hour.

Total computed hourly operating cost—including gas and electricity, maintenance mechanic, depreciation, and interest—comes to $9.80 per hr for the 870 ton plant system, or 1.11 cents per ton per operating hr. ≠

Big Boom Is on the Way Need Engineer-Executives

. . . to fill top level jobs

A SURVEY of 612 of the nation's leading corporations made by Hoff, Canny, Bowen & Associates, Inc., "executive search specialists," finds that an economic boom is in the making. It will probably begin in 1959-60 and be in high gear by 1964-65.

The three most important occupational classifications are mechanical engineering, industrial engineering, and chemistry. But while the need is great, 78 percent of the companies surveyed find it hard to get top scientific-technical executives who are equally strong in administrative skills. ≠

SAM LEWIS SAYS...

"Air Vents Would Have Exhaled, Diluted Corrosive Gases"

. . . to prevent steam line deterioration

AN EARLY encounter with pipe corrosion in my personal experience was in the steam piping system of a six-story industrial building. It was operated at a steam pressure of 50 psi.

The ends of each steam main and the condensate outlet of each heater were equipped with float traps. This trap in each case was below the bottom of the heat transfer coil. Condensate from the traps was piped to a centrifugal pump which forced it, under several pounds' pressure, to an open hot well which served as a water reservoir for the boiler feed pumps.

After about three years' operation, the steam pipe risers in several locations were corroded through. The escaping hot water and steam caused serious damage to merchandise being manufactured.

I was called in to determine the cause of this rapid corrosion and to prescribe a means of correcting the trouble. I found that the steam pipes — both horizontal and vertical — had been eaten through from the inside.

I concluded that the excessive corrosion had resulted from exposure of the pipes to gases released from the water when it was heated. These gases could not escape through the airtight steam traps and, as a result, the piping was destroyed.

If air vents had been provided, they would have exhaled and diluted the corrosive gases. The serious damage, however, could be corrected only by re-piping the entire heating system.

As it was, I replaced all of the steam piping and fittings and substituted mechanically-circulated water for the original 50 psi steam. Fortunately, the original unit heaters were capable of using water at an average temperature of 250 F instead of the original steam.

Experience with this plant was checked by a parallel one in another area where adequate venting of the corrosive gas inside the steam pipes had failed. A friend who disagreed, suggests that a steam pressure of 2 psi should be sufficient to keep out the excess air in any steam heating system. He fails to consider the air — a complex gas — that is entrained in the makeup water that enters the steam boiler. This gas travels along with the steam.

I favor a vacuum pump on most steam systems because it has proved to be reliable for me in working with these systems.

Some air valves are supposed to breathe the air out of these systems, but many of them also let air enter when the steam pressure drops below atmospheric pressure. Hence, the type of valve for this purpose should be selected carefully.

My friend likes to use a swing check valve in the condensate outlet from a radiator. These check valves do not work for me when handling a mixture of gas-air and water, even though they may close when full of water on both inlet and outlet sides. They fail to prevent counterflow of gas or steam and refuse to permit through-flow unless a head of water exists at the inlet with enough differential pressure to lift the flapper of the check valve. ✣

SAMUEL R. LEWIS, *consulting mechanical engineer and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors, comments informally each month on practical problems in the field.*

FUEL OIL:

What Every Heating Engineer

How much do you know about fuel oil? Questions and answers on the fundamentals of this vital fuel are listed here — including what fuel oil is, its composition, its economic aspects, its heating values, how its various grades are best used, how to find its specific gravity and API gravity and what they mean, the importance of viscosity on successful combustion and how it is measured, and many other basic facts.

BY WILLIE HAMMER
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Q: *What is* fuel oil?

A: *Fuel oil* is any liquid petroleum product, heavier than gasoline, which can be used for heating purposes. In composition, fuel oil is a mixture of various compounds of carbon and hydrogen known as hydrocarbons. They differ in molecular arrangement, weight, and complexity.

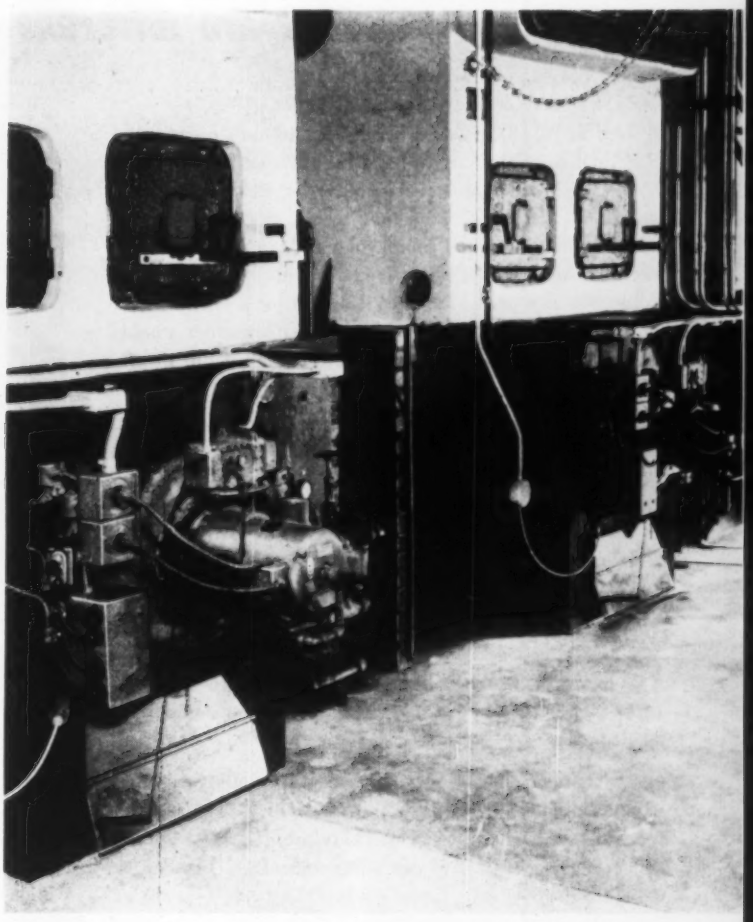
Q: *How do these molecular arrangements differ?*

A: Four of the groups of hydrocarbons having different molecular arrangements are the paraffins, naphthenes, aromatics, and olefins. Paraffins are composed of molecules with the general formula C_nH_{2n+2}, where n is a whole number; naphthenes and olefins are of the formula C_nH_{2n}; and aromatics are of the formula: C_nH_{2n-6}. Hydrocarbons may have the same numbers of carbon and hydrogen atoms but may have different arrangements of bonds between them.

Q: *Do these different arrangements produce oils with different characteristics?*

A: Yes. Generally, aromatics have higher specific gravities than the other types, and paraffins have the lowest. Paraffins are very stable toward oxidation or

Should Know



IN MANY commercial and industrial oil burning installations, Nos. 5 and 6 fuel oil are used. Preheating of these heavier oils is usually necessary, to increase fluid flow, aid combustion efficiency

chemical changes, have the highest hydrogen-carbon ratios, and are clean burning. Aromatics have higher ratios of carbon to hydrogen, giving them a tendency to smoke. Olefins are less stable than the others of these groups and have a tendency to oxidize to form gums.

Q: *What are the differences between* distillate, residual *and* blended *fuel oils?*

A: Crude oil processed at a refinery is separated into its constituent fractions by boiling or distillation. The lighter portions boil off first and are condensed in separate vessels. The kerosene and light oils so obtained are *distillate* fuel oils. The remainders of the crude oil which have been left are called *residual* fuel oils. *Blends* are mixtures of distillate and residual oils prepared to give certain desirable properties. Distillate oils are used for domestic heating; residuals and blends are used in large commercial, industrial, marine, and power boiler plants.

Q: *What are* cracked *and* straight-run *distillates?*

A: In order to produce more of the lighter and more profitable products, the heavier oils are processed to split their molecules into less complex arrangements. This process is known as *cracking*. *Straight-run* distillates are those products obtained from crude oil simply by distillation without molecular changes.

Q: *How do the properties of cracked and straight-run distillates differ?*

A: Cracked fuel oils sometimes do not burn as clean, have lower viscosities at the same gravities, have lower viscosity indices, possess lower pour points, and have slightly higher heat contents per unit of volume than straight-run oils.

Q: *Why don't cracked fuel oils burn as clean as distillate fuel oils?*

A: Cracked fuel oils usually consist of hydrocarbons with higher ratios of carbon (the soot forming element) to hydrogen in their composition than in similar products obtained by straight-run distillation.

Q: *For the large consumer, which type of oil may offer economic advantages?*

A: Purely on a calorific value basis, if offered a choice at the same price per gallon of cracked or straight-run

"What are different grades of fuel oil? With

oil such as No. 5, it would be cheaper to use the cracked oil. Cracked fuel oils may have higher specific gravities than straight-runs and therefore lower calorific values *per pound*. However, since they weigh more per gallon, the calorific value per unit volume is higher for the cracked oils. A straight-run No. 5 oil may have a value of 146,000 Btu per gal against 150,000 for a cracked oil. Thus, for every 1000 gal purchased, the consumer would obtain 4000 × 1000 Btu more with cracked oil, or 27 gal extra.

Q: Which oil would have the higher heating value, one with a high carbon to hydrogen ratio, or vice versa?

A: When one pound of hydrogen is burned, 62,000 Btu are produced; when the same amount of carbon is burned, the heat release is only 14,600 Btu. Thus, as the percentage of hydrogen increases, the amount of heat released per unit weight of hydrocarbon increases.

Q: As the amount of hydrogen present increases, doesn't the loss of heat required to vaporize the water formed also increase?

A: The loss due to vaporization of a pound of water is approximately 970.2 Btu. Two parts of hydrogen combine with one part of oxygen. Therefore, if 1 lb of hydrogen is burned, 9 lb of water will result. Total loss due to moisture formed will therefore be 970.2 × 9, or 8730 Btu, and the net gain from burning 1 lb of hydrogen will be 62,000 − 8730, or 53,270 Btu. (These values are approximate and do not account for such factors as the heat required to raise the temperatures of the hydrogen, oxygen, and water from initial to final temperatures.)

Q: About how much water will be formed by combustion of a pound of fuel oil?

A: Approximately 1 lb of water per lb of fuel oil.

Q: What are some of the different grades of fuel oil? With what types of equipment are they normally used?

A: Grades are usually designated as follows: No. 1, distillate oil for vaporizing pot type burners; No. 2, distillate oil for general purpose domestic heating for burners not requiring No. 1 fuel oil; No. 4, for burner installations not equipped with preheating facilities (oils in this grade are usually blends of other grades); No. 5, residual type oil for installations equipped with preheating facilities; and No. 6, residual type oil for use in installations equipped with preheaters permitting use of a high viscosity fuel.

Q: What is the principal advantage of using residual fuel oil?

A: It's usually a lot cheaper.

Q: What is distillation end point?

A: In testing the volatility of oils, 200 milliliters are evaporated under controlled conditions during which temperature readings are made at the points at which each 10 percent of volume is distilled. The end point is the maximum temperature observed, usually after distillation is completed. The test for end point is usually required only on No. 1 fuel oil.

Q: What is the significance of the 10 percent distillation point?

A: This is the temperature at which 10 percent of the total volume will have distilled off. It reveals the amounts of light oil fractions present. These light oil parts will distill and burn at comparatively low temperatures and therefore are indicators of the suitability of an oil for use in different types of burners. This is especially indicative when considered together with information on whether the fuel being considered will or will not leave substantial amounts of carbon residue. If the 10 percent point is fairly close in temperature to that at which the oil first begins to boil off, there should be little trouble in maintaining continuous combustion.

Q: What is the significance of the 90 percent distillation point?

A: If there is a substantial difference in temperature between the 90 percent and end points, it may mean the oil has been contaminated or blended, or contains very heavy parts which will produce high carbonization.

Q: What limitations are recommended for fuel oil to be used in vaporizing type burners?

A: It is recommended that oils for this application be limited to those having maximum end points of 625 F and minimum gravities of 35 deg API.

Q: What are some of the advantages and disadvantages of using steam atomizing burners?

A: Among the advantages are low first cost, adaptability for variable loads, wide variety of possible flame shapes, and wide capacity range for any certain tip. Also, frequent cleaning is unnecessary, and comparatively low oil temperatures and pressures are required.

Some of the disadvantages are that part of the steam produced is lost (in inefficient operations, this may be as high as 6 to 7 percent) and replacement of water is required; presence of additional amounts of moisture when wet steam is used will cause corrosion of metal surfaces; and auxiliary starting equipment is required.

Q: Likewise, what are the advantages and disadvantages of mechanical atomization?

what types of equipment are they normally used?"

A: On the plus side: boilers can be started without need for auxiliary equipment (such as an air compressor) when steam is not available; it is well suited for high output and steady loads; it can be used on hot water boilers; there is no loss of water as steam in the furnace; and there is less corrosion of metal surfaces. Some negative aspects are the need for relatively high oil temperatures and pressures, higher first cost, limited flame shapes and capacities for any certain tips, and the necessity for frequent cleaning of tips.

Q: *What is the effect on the temperature in a furnace if very wet steam is used in a steam jet burner?*

A: The temperature is reduced because the moisture in the steam absorbs heat to vaporize, and all the steam injected into the furnace requires heat to be superheated to the furnace temperature.

Q: *How is* specific gravity *of oil measured?*

A: The *specific gravity* of an oil may be measured by means of a hydrometer which indicates its specific gravity in relation to water under standard conditions, or in *degrees API*.

Q: *What is the meaning of the expression* Specific Gravity 60/60 F?

A: This expression means that the specific gravity of a fuel oil has been determined with both oil and water at temperatures of 60 F.

Q: *What are* degrees API? *Why is the term used?*

A: *Degrees API* have the following relationship to specific gravity when both oil and water are at 60 F: Degrees API = 141.5/specific gravity − 131.5. Degrees API are easier to use than specific gravity and more accurate when hydrometers or pycnometers are so calibrated. Specific gravities must read to four decimal places for any accuracy. For example, API gravities of 25.0 and 25.1 are equivalent to specific gravities of 0.9042 and 0.9036.

Q: *What are the approximate API gravity ranges of the various grades of fuel oil?*

A: The ASTM specification lists minimum gravities of 35 for grade No. 1, and 26 for No. 2. There are no others listed. However, gravity ranges usually run as follows: No. 1, 35 to 45; No. 2, 26 to 40; No. 5, 13 to 23; and No. 6, 9 to 16. Grade No. 4, which is a blend, may overlap other grades and vary from 15 to 32.

Q: *What are* degrees Baume?

A: Gravities of liquids were formerly rated according to Baume scales, similar to the present API scale. For liquids lighter than water the relationship between *degrees Baume* and specific gravity is:

$$\text{Degrees Baume} = (140/\text{specific gravity}) - 130$$

For liquids heavier than water:

$$\text{Degrees Baume} = 145 - (145/\text{specific gravity})$$

Q: *Is API gravity a reliable indicator of fuel oil characteristics?*

A: Because of the different molecular arrangements of the hydrocarbons, fuel oils having the same API gravity may have different characteristics. When comparing oils from the same fields which have undergone the same processing, use of API gravity may be accurate. However, oils from different fields or which have undergone different processing (one may be straight-run, another cracked) may have characteristics which vary greatly even though they have the same gravity and grade.

Q: *Is there any relation between API gravity and the calorific value of a fuel oil?*

A: The Oil-Heat Institute of America uses the following formulas for total heat:

$$\text{Distillate fuel oil: Btu per lb} = 18{,}250 + (\text{API gravity} \times 40)$$
$$\text{Residual fuel oil: Btu per lb} = 17{,}690 + (\text{API gravity} \times 58)$$

Other investigators have developed other formulas for approximate uses. The National Bureau of Standards' Miscellaneous Publication No. 97 has a table of heating values of fuel oils corresponding to API gravities based on investigations by that organization. The Naval Boiler and Turbine Laboratory uses the following formula for total heat of Navy Special fuel oil:

$$\text{Btu per lb} = 17{,}601 + 53.1\ (\text{API deg})$$

Q: *If the API gravity of an oil is* 16.2, *what is its weight per gallon and approximate gross heating value as determined using the OHI formula?*

A: First, it is necessary to convert API gravity to specific gravity:

$$\text{Specific gravity} = 141.5/(131.5 + \text{deg API}) = 141.5/(131.5 + 16.2) = 0.9580$$

Water at 60 F weighs 8.328 lb per gal. Therefore this oil weighs $8.328 \times 0.9580 = 7.978$ lb per gal. So,

$$\text{Heating value per lb} = 17{,}690 + 58.0\ (16.2) = 18{,}630\ \text{Btu}$$
$$\text{Heating value per gal} = 18{,}630 \times 7.978 = 148{,}630\ \text{Btu}$$

Q: *About how much heat is in a gallon of oil of each different grade?*

A: No. 1, 136,000 Btu; No. 2, 138,500 Btu; No. 4, 145,000 Btu; No. 5, 148,500 Btu; and No. 6, 152,000 Btu.

Q: *What is the difference between* total *or gross heat and* net *heat of combustion of a fuel oil?*

"What is viscosity? How is it measured? What

A: *Total heat* is the heat content of oil contained in the combustible material. *Net heat* is total heat less heat absorbed in the vaporization of water formed by combustion of hydrogen in the oil. The latter is more indicative of true combustion conditions in making comparisons of fuels or of efficiencies of operations.

Q: *How is net heat determined?*

A: To determine net heat it is necessary to know the amount of hydrogen in the oil. Heat loss due to hydrogen content can be computed by the equation: hydrogen heat loss in Btu per lb = percentage of hydrogen in the fuel × 87,336. This loss is then subtracted from the gross heating value to give the net.

Q: *Is there any way to determine the amount of hydrogen in a fuel oil, without a complete laboratory analysis?*

A: The National Bureau of Standards uses a formula something like this, where d is the specific gravity:

$$\text{Percent hydrogen} = 26 - 15d$$

Q: *What tests are usually performed to determine the characteristics of fuel oil?*

A: Cloud and pour points, gravity, viscosity, sulfur, flash and fire points, water and sediment, and distillation tests.

Q: *What are* cloud *and* pour points?

A: As oil temperature is reduced, waxes may begin to drop out of solution. If this is noticeable before the oil solidifies, the temperature at which it happens is called the *cloud point*. This test should be used only for oils which are transparent when they are at least 1½ in. deep. The temperature at which oil just barely flows under certain standard conditions is known as the *pour point*.

Q: *If wax actually separates from oil, is there any way it can be put back into solution?*

A: Yes. When the temperature of the oil and wax mixture is raised sufficiently, the wax will re-dissolve.

Q: *Why is it necessary to know the pour point?*

A: If the oil is to be used in a zone where the temperature may drop below the pour point, congealing of oil in the heating equipment may result in blockage of tank outlets, pumps, and oil lines.

Q: *If the outside temperature is low enough to drop the oil below its pour point, how can the oil be kept from congealing if heating coils are not available in the tank?*

A: Recirculate the oil, if possible, through the boiler plant preheater and then back to the tank; add a lighter oil with a higher pour point; or agitate the oil either by blowing compressed air through it or by mechanical means.

Q: *What are* flash *and* fire points *of oil?*

A: *Flash point* is the temperature at which fuel oil will form an inflammable mixture in the presence of air, but at which combustion can be supported only for a very short period because the oil vapors are consumed faster than they are produced. *Fire point*, on the other hand, is the temperature at which vapors are produced rapidly enough to support continuous combustion. The fire point of an oil may be 10 to 120 F deg above its flash point. In both cases, external ignition is necessary to cause combustion.

Q: *What might be the effect of the presence of sulfur in fuel oils?*

A: Sulfur burns to sulfur dioxide which combines with water to form sulfurous acid. When flue gas temperatures are low enough to permit condensation of this vapor, corrosion of steel surfaces on which it forms will probably result. Sulfur dioxide also raises the temperature at which condensation will take place. Also, in an improperly operated furnace in which there is a shortage of air and oxygen, one of the resulting gases may be hydrogen sulfide, which has an odor similar to that of rotten eggs.

Q: *How does the presence of sulfur affect the heat content of fuel oil?*

A: When a pound of sulfur is burned, only 4000 Btu is released. This is compared to 14,600 Btu per lb of carbon and 62,000 Btu per lb of hydrogen. Thus, the presence of sulfur may reduce the heat content of a fuel oil.

Q: *Why are tests of water and sediment in oil made?*

A: When these are present in oil, the purchaser is paying for deleterious, unusable materials which can cause malfunctioning of his equipment, clogging of strainers and nozzles, erosion of nozzles, corrosion of tanks, and waste of heat necessary to vaporize the water. The reasons are obvious.

Q: *What is* viscosity?

A: *Viscosity* is the resistance to flow of a liquid. As it increases, flow decreases. The unit of absolute viscosity is the *poise*, or the force required to move at a rate of 1 cm per sec a surface 1 sq cm in area parallel to a similar surface from which it is separated by a layer of fluid 1

is its relationship to temperature?"

cm thick. Viscosity is usually the most important single property specified in the purchase of a heavy fuel oil.

Q: How is viscosity of fuel oil usually measured?

A: Viscosity is most commonly determined using systems based on kinematic methods which measure the time required for a specified amount of liquid at a specified temperature to move through a capillary tube, or to pass through a calibrated orifice. Kinematic viscosity, which measures movement through a glass capillary tube, is usually more accurate, with results obtainable in a basic viscosity unit, the *centistoke*. Kinematic viscosity is equal to absolute viscosity divided by the density of the oil. Saybolt viscosimeters are normally used for industrial purposes to measure viscosity. In this method, it is expressed as the time for the sample to flow through an orifice under standard conditions. An oil rated in seconds by Saybolt Universal (SSU) indicates it has taken that length of time for 60 cc to flow through an orifice at a specified temperature which may be 70, 100, 130, or 210 F. Saybolt Furol (SSF) is determined by the same procedure for more viscous oils (having viscosities greater than 1000 SSU) using a larger orifice. Usual temperatures are 77, 100, 122, and 210 F. A viscosity of 62 SSF = 600 SSU at 100 F.

Q: What are the relationships between SSU and Kinematic viscosity, and SSF and Kinematic viscosity?

A: If K is Kinematic viscosity, t is SSU, and t' is SSF; then $K = 0.22t - 180$ and $K = 2.2t' - (283/t')$.

Q: Is there any direct proportional relationship between Saybolt viscosities which are expressed in seconds and absolute viscosities in poises?

A: There is a rough proportional relationship for oils with Saybolt viscosities of more than 200 sec. But there are none at all for viscosities less than that. Absolute viscosity can be obtained from Saybolt viscosity by use of the proper formula which relates Kinematic and Saybolt viscosities and then multiplying the Kinematic viscosity by the specific gravity of the oil in question.

Q: What are some of the effects viscosity can have in an oil burning plant?

A: Heavy oils may not be finely enough atomized unless preheated; the spray angle from a nozzle may decrease as viscosity increases; changes in viscosity necessitate changes in the amount of air necessary because of changes in volume of oil sprayed; viscosity will determine the sizes of pumps, motors, and diameters of fuel lines necessary to transport the oil; and changes in viscosity may result in pulsations in the flame and in sooty, sparky fires.

Q: Which has the greater effect on viscosity, a temperature or a pressure change?

A: Temperature changes, by far.

Q: What is the relationship between temperature and viscosity?

A: Viscosity varies inversely with temperature. If the viscosities at two or more temperatures are known, a straight line drawn through these points on an ASTM Standard viscosity-temperature chart will indicate estimated viscosities up to the boiling point of the oil and down to the cloud point. The exact method of preparation of one of these charts is indicated in ASTM Standards.

Q: What is viscosity index *of an oil?*

A: *Viscosity index* is a rating number which indicates the effect that a change of temperature has on the viscosity of an oil. A low index for an oil indicates that temperature affects its viscosity to a comparatively great degree.

Q: What are the most important factors in the efficient combustion of fuel oil?

A: Probably the most important are proper vaporization of oil, an adequate but not unduly excess supply of air, and the shapes of the flame and combustion chamber.

Q: Do pressure burners actually vaporize fuel oil, or do the oil droplets burn as such?

A: Oil must be in the form of gas before it will burn. In a vaporizing burner, the heat of the oil or of the chamber causes the liquid to change to a gas which ignites in the presence of air. With a pressure type burner, the oil is broken into a spray of fine droplets which turn to gas and burn when exposed to the heat in the furnace. The fineness of the spray and the heat in the furnace determine how fast volatilization of oil from the surface of the droplets will take place.

Q: What effects do flame and combustion chamber shapes have on this process?

A: Proper chamber shape is necessary to confine and direct the combustion and to reflect heat back into the oil in order that the necessary change from liquid to gas will take place. Proper flame shape is necessary to distribute the droplets of oil in such a manner that the temperature throughout the oil cloud will be of as uniform temperature as possible. This will permit the oil to change to gas and burn at the same rate throughout.

Q: If the spray shape is not suitable for the combustion chamber, what might happen?

A: With uneven temperatures throughout the spray,

some droplets may not change to gas if the temperature is too low and may be deposited on the furnace surfaces. If the temperature is too high, the oil which is still liquid may crack and form carbon which may deposit as soot on surrounding surfaces. It may be difficult to supply air for combustion properly if the spray is odd shaped or not uniform.

Q: What can happen if a combustion chamber is of wrong size or shape?

A: Poor oil volatilization may exist in an excessively large chamber because of the lack of reflected heat. The result would be incomplete combustion and consequent soot. A small chamber might not permit combustion to be completed in the furnace. Therefore it may take place in the secondary passages, with resultant high flue gas temperatures and heat loss. Incorrectly sized chambers can result in flue gases with low CO_2 content, smoke, flame pulsations, soot deposits, poor efficiency, and excessive oil consumption.

Q: How does a change in oil viscosity affect the spray angle of a nozzle?

A: Usually, as viscosity increases, the spray angle of oil entering a furnace decreases.

Q: What is the effect of a change in oil viscosity on the output of a rotary burner?

A: As viscosity increases, the film of oil grows thicker and the volume of oil discharged increases.

Q: If a specification calls for a fuel oil less viscous than No. 5 but more viscous than No. 2, what should be used?

A: A blend should be prepared using a residual oil with enough oil of lower viscosity, such as a No. 2 oil, added until the desired requirement is met.

Q: What is meant when an oil company indicates that an oil is No. 5-250?

A: This means it is a No. 5 oil with viscosity of 250 SSU at 100 F.

Q: When the temperature of oil delivered is different from that at which it was loaded, wouldn't the volumes be different with possible discrepancies in the billings and receipts?

A: All volumes should be corrected to a standard temperature of 60 F to eliminate such possible differences and discrepancies.

Q: What effect does preheating have on the calorific value of fuel oil?

A: Preheating will cause the oil to expand and reduce the calorific value per gallon of fuel. However, the calorific value per pound of fuel will not be affected.

Q: Can overheating of fuel oil have adverse effects?

A: Overheating may cause coking and formation of tars in the heaters and therefore the loss of some carbon which would otherwise be burned in the furnace. The serious result is the necessity for cleaning the tubes and piping to prevent stoppages.

Q: To what temperatures should residual fuel oils be preheated prior to atomization?

A: The Bureau of Mines in its Bulletin 466 states the following: No. 5 oil, usually burned cold, will atomize and burn better if heated to 110 to 130 F. For No. 6 oil 160 to 180 F is usually sufficient for steam atomizing burners, 200 to 250 F is adequate for mechanical-pressure atomizing burners, and 140 F is enough for rotary oil burners if oil is heated in the suction line. A temperature of 180 F is better for No. 6 oil when used with rotary oil burners if the oil is heated under pump pressure. For low air pressure oil burners 200 F is recommended. For Navy Special fuel oil in the viscosity range of 15 to 25 SSF at 122 F, the Navy recommends that an approximate optimum burning temperature be determined by adding the SSF viscosity at 122 F to 115 F. For example, if the viscosity is 21 SSF, the best atomizing temperature would be 21 + 115, or 136 F.

Q: What is the normal viscosity of No. 5 oil?

A: No. 5 oil ranges from 150 SSU at 100 F to 40 SSF at 122 F.

Q: What effect does soot have on the performance of a boiler?

A: Tests made on a small boiler by personnel of the Bureau of Standards indicated that, after operations during 8 days with 10 percent of carbon dioxide in the flue gases, a layer of soot approximately 1/32 in. thick accumulated, efficiency dropped to 63 percent from 67 percent, flue gas temperature increased to 790 F from 600 F, and output dropped to 127,400 Btu per hr from 136,000 Btu per hr with the same firing rate. The decrease in output was even more substantial (down to 70,850 from 136,000 Btu per hr) when the firing rate was adjusted to provide the same flue gas temperature (600 F) throughout the test.

Q: What precaution should be taken when relighting an oil fire in a furnace?

A: Before attempting to relight a fire, the furnace should be cleared of all combustible gases that might ignite explosively and thereby damage the furnace walls, boiler, or tubes.

Q: Why are additives used in fuel oil?

A: They increase the fluidity of sludge in heavy oils, reduce the amount of soot deposits on firesides of boilers thereby increasing efficiency, reduce the amount of carbon on burner tips, and result in cleaner lines and equipment and consequent more even combustion.

The Law and Your Profits

BY WILLIAM HURD HILLYER

Greedy Contractor's Ill-founded Claims Save Piping Subcontractor's Shirt

FULFILLMENT of a contract's time clause is important and should be a matter of concern—particularly if implemented by penalties. The piping subcontractor in the following case would certainly have suffered a larger money loss if the general contractor had not been overly greedy. But few are born under such a lucky star. It is a must for the subcontractor to promptly fulfill his undertakings.

Tufman Construction Co. was the general contractor for a U. S. Government building project. Manyana Bros. subcontracted to furnish material and labor on piping and related installations.

A clause in Tufman's contract with the U. S. stipulated liquidated damages of $100 a day for delay in performance. Under this clause Uncle Sam withheld payments of $9300. Tufman and Manyana had a like clause in their contract under which Tufman withheld $7900 for 79 days' delay due to Manyana's alleged failure to perform as agreed.

After a few weeks the Government waived the liquidated damages of $9300 to Tufman, who thereupon credited Manyana with the $7900. Manyana sued Tufman for $27,290 balance on contract, plus $915 for extras.

Tufman countered with a general denial and a cross-petition claiming that Manyana, in point of fact, owed him $103,914 for damages he suffered because of Manyana's nonperformance or ill performance of the piping contract. In addition, Tufman claimed $2875 covering materials and labor he had furnished Manyana for which credit had not been given.

The trial court allowed Tufman two of the relatively minor items in his cross-suit and disallowed the remaining seven. The largest of those denied was a claim of over $68,000 for "loss of normal profit," alleged to have been caused by Manyana's "negligence and delay in performance."

Within the labyrinth of legal technicalities and assignments of error threaded by the court on Tufman's appeal, this heavy claim seems to have produced an effect quite different from what was intended. To sustain this item, said the state supreme court, Tufman had analyzed his gross profits on contracts for five years and on two other jobs for the U. S. On one of these he had made a gross profit of 13.25 percent. Hence, he calculated that percentage upon $519,297 listed as "gross sales" in this contract and thereby arrived at $68,832 as his loss of profit.

It appears, continued the court, that Tufman was relying on the theory that, because he had made gross profits on his other contracts, he should also have done so on this one. In line with this theory, defendant Tufman reasoned that plaintiff Manyana was "obilgated to make up the loss."

Advised by defendant Tufman that the trial court "had difficulty in understanding" this exhibit, the higher court commented:

"We have thought that the trial court understood the exhibit but had difficulty in understanding upon what possible theory it could be used as a foundation proof for the damages claimed. We concur . . . The general rule is that damages, to be recoverable, must be direct and certain."

On the other hand, "damages which are uncertain, contingent, conjectural, or speculative cannot be made the basis of a recovery, whether applied to the existence, nature, or proximate cause thereof."

The state supreme court affirmed the trial court's judgment in favor of the piping subcontractor.

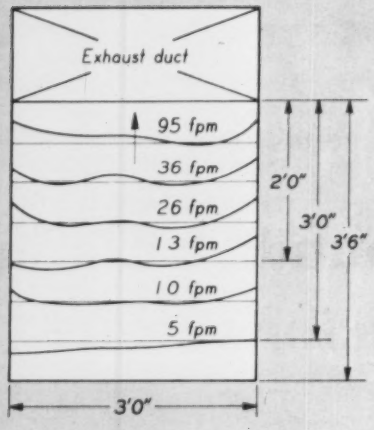
A casual reader of the record in this case gains the impression that the prime contractor did suffer damage by reason of the delay in piping installation. He might have been credited with a more substantial offset if if had not been for his fantastic claims unsupported by evidence.

According to the court these tactics wore out the patience of a "patient judge." If Tufman's case had not been so grossly mishandled, piping contractor Manyana would, without question, have paid dearly for his delayed performance.

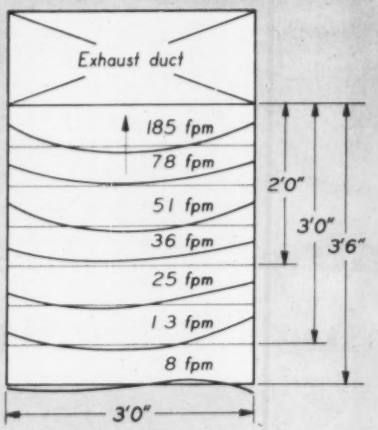
That the prime contractor was heavily damaged by the subcontractor's late performance (no doubt negligent) is manifest and, so far as the record goes, undisputed. The point at issue was the general contractor's claim that such damage exceeded in amount the balance due. His failure to substantiate that claim was what saved Manyana's pocketbook. ±

WILLIAM HURD HILLYER, *author of this regular feature, is a contributor to a number of banking and financial publications and has written several books on business. He has an extensive practical legal and financial background.*

This series presents actual cases. All names are, however, fictitious. It should, of course, be remembered that laws vary in different states.



1 AIR FLOW CONTOURS for slot exhaust over test table at 1120 cfm exhaust volume are plotted here



2 1900 CFM VOLUME revealed these contours. Readings for this, and for Fig. 1, were taken with table edge 3 ft, 6 in. from slot

What Are Limits of Slot Exhaust?

. . . it's volume of air exhausted — not high velocity — that really counts

BY A. B. EPPLE
Associate Professor
Mechanical Engineering Dept.
University of Michigan

WHAT ARE THE LIMITS of a slot exhaust system? What are the relationships of velocity and volume to its ability to remove fume or smoke laden air? Tests have been conducted by the University of Michigan department of mechanical engineering in an effort to answer these questions.

To show the effect of different velocities, two air volumes were used. Readings taken during these tests are plotted in Figs. 1 and 2. At first glance these velocity contours represent little more than a lot of incidental data. But they take on real meaning after you refer to Figs. 3 through 8.

Figs. 3, 4, and 5 show the testing conditions when air was removed at 1120 cfm. In Figs. 6, 7, and 8 the volume had been increased to 1900 cfm.

These illustrations show that for "still" air the lower volume would control for 2 ft, and the higher volume for 3 ft. In both cases the velocity of air created by the slot is 13 fpm. They also show that the higher volume of flow will maintain control over a 2 ft—but not a 3 ft—table when a person walks past. The contour plot of Fig. 2 indicates that a velocity toward the slot of 36 fpm is needed to maintain control.

The general effect of the higher volume is reflected by a comparison of the two series of pictures—Figs. 3 through 5 and Figs. 6 through 8—and, in particular, Figs. 5 and 6. With the lower volume, the smoke collects on the table or rises from it at the extreme distance. For the higher volume, however, stronger currents prevent the smoke from staying on the table or rising from it.

How Can Volume Be Determined?

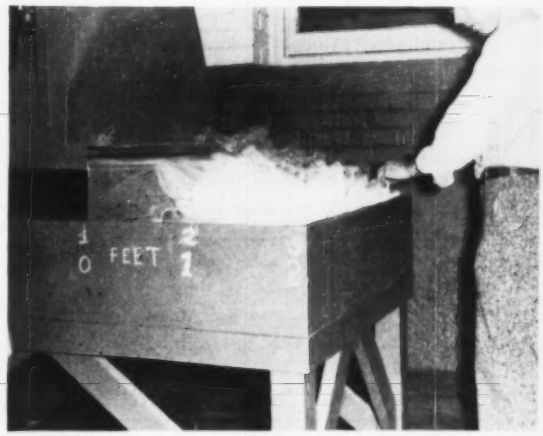
The final problem is design. When the desired velocity and distance from the slot are known, how can the volume be determined to give this velocity?

A lot of attempts have been made to answer this. Some involve selecting a slot width and velocity, or choosing a control velocity at the extreme distance, or selecting an air volume to be removed per square foot of table surface. The last method seems best to me, and Table 1 gives the values on this basis for the tests discussed here.

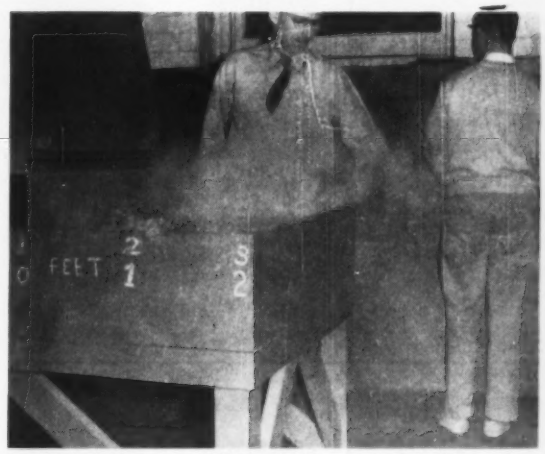
A few more design factors may be helpful to those not thoroughly acquainted with slot design:

1) A slot velocity of around 2000 fpm is usually satisfactory under most conditions.

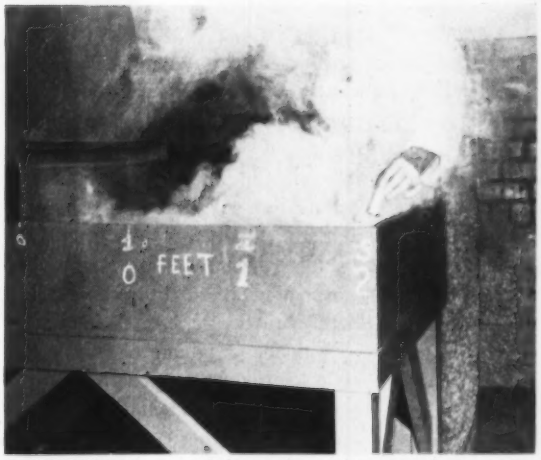
at 1120 cfm —



3 SMOKE RELEASED 2 ft from slot is drawn in when no cross drafts exist. ("Still" air movement was 5 fpm)

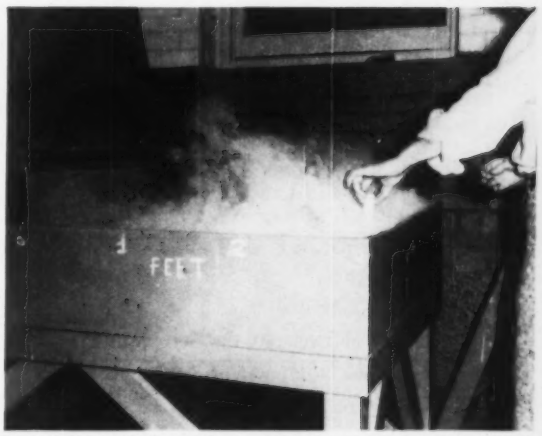


4 BUT WHEN PERSON walks by, creating draft condition, some smoke is drawn off table



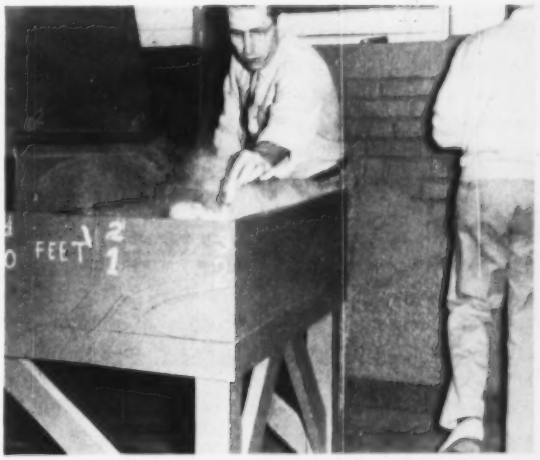
5 IF TABLE is extended to 3 ft, smoke released along edge will not be drawn into slot, even under still air conditions

at 1900 cfm —



6 AT 1900 CFM, smoke generated 3 ft from slot in still air is drawn to slot in satisfactory manner

7 DISTURBANCE, caused by person walking by, shows that velocity toward slot is not high enough to counteract it



8 SO SLOT can maintain control, length of draw from edge of table to slot must be shortened to 2 ft

2) A higher value gives no improvement in operation and requires a higher hood suction.

3) The velocity in the collecting hood should be one-third of the slot velocity to assure even distribution along its length.

Solve Sample Problem

The following example puts all these together:

Suppose slot exhaust is to be provided to remove smoke from a cold table 3 ft long × 2 ft wide. Minor local disturbances are anticipated. From Table 1 select a value of 316 cfm per sq ft. Then,

Volume = $316 \times 3 \times 2 = 1900$ cfm.

For a 2000 fpm slot velocity the slot width will be

$(1900 \times 144)/(2000 \times 36) = 3.8$ in. (say 3¾ in.).

Entrance coefficent for the slot may be taken as 0.60. Since this coefficent is the ratio of the actual rate of flow to the theoretical, then

$$C_e = 0.60 = 2000/V_{theo}$$

or

$$V_{theo} = 2000/0.60 = 3340 \text{ fpm.}$$

TABLE 1—VOLUMES AND VELOCITIES for table slot exhaust tests summarized

Test volume, cfm	Calculated slot velocity, fpm	Volume, cfm per sq ft, 2 ft table (6 sq ft)	Volume, cfm per sq ft, 3 ft table (9 sq ft)
1120	2240	187	125[1]
1900	3800[2]	316	211

[1]Not recommended.
[2]Slot opening could be made wider, reducing this velocity. High velocity is of no value; again, it is volume that counts.

How Tests Were Conducted

The slot exhaust tests described in this article were conducted using a 3 ft × 5 ft table on rollers which could be moved to different positions under a slotted hood. Air collected at the table was drawn into a steel plate fan and then blown through a nozzle where it was measured. Air velocity readings were taken with a heated wire anemometer 6 in. above the table and at points 6 in. apart when the table edge was set 3 ft. 6 in. from the slot. From these readings were derived the air flow contours shown in Figs. 1 and 2. The table edge was 3 ft. 6 in. from the slot for the contour readings only. This made values at all distances comparable.

This is the velocity for perfect conversion of the static suction in the hood. The hood suction pressure is then

$$SP = -(3340/4005)^2 = -0.7 \text{ in. water gage.}$$

If the air velocity in the hood is to be one-third that of the slot, the depth must be

$3 \times 3\frac{3}{4} = 11\frac{1}{4}$ in. (say 12 in.).

If no material is to be carried into the collecting duct, 2000 fpm will be a desirable velocity. Then, for a transformation having 45 deg sides, the loss is 25 percent of the duct velocity pressure.

Trans. loss = $(-0.25) \times 0.25 = -0.063$ in. WG.

The suction at the connection to the trunk must then be

$$SP = -0.7 + (-0.063) = -0.763 \text{ in. WG.}$$

Unusual Technique Creates Extremely High Vacuums

. . . for research, industrial applications

AN UNCONVENTIONAL technique for producing extremely high vacuums promises substantial savings to research and industrial users. It is already employed for missile research in a University of Southern California wind tunnel. The technique, called "cryopumping," was explained recently to members of the American Vacuum Society at the Third National Vacuum Symposium, San Francisco.

Cryopumping produces such a low temperature that all of the air in a chamber or wind tunnel freezes to a solid, leaving a high vacuum.

Details of the technique were delivered by Bruce M. Bailey, of Arthur D. Little, Inc., in a paper co-authored with Raymond L. Chuan, director of the University of Southern California's Engineering Center.

Dr. Chuan developed the first practical, large scale application of the technique— a hypersonic wind tunnel used to test missile models under high altitude atmospheric conditions. Mr. Bailey and his colleagues at Arthur D. Little developed the cryopump used to freeze air out one end of the tunnel, providing high speed air flow over the missile models. The wind tunnel was unveiled only recently.

The cryopump is an extremely low temperature refrigerator, using helium gas at −420 F as the refrigerant. At present cryopumping is most efficiently used in conjunction with mechanical pumps. Whereas the pumping speed of a mechanical system falls off rapidly as the vacuum increases, a cryopump works particularly well when a relatively high vacuum exists. Such a combined system makes use of the advantages of both methods.

With the cryopump, it is now possible to produce extremely low pressures (about one one-millionth of our normal atmospheric pressure) economically enough for large scale industrial applications.

Pipe Welding Terms Defined

BY HELMUT THIELSCH
Metallurgical Engineer
Industrial Piping Div.
Grinnell Co., Inc.

This is a continuation of a listing of pipe welding terms and their definitions which was started in last month's Data Sheet.

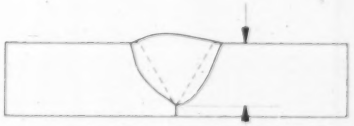
Incomplete fusion: Fusion which is less than complete and does not permit complete joint penetration.

Inert-gas tungsten-arc welding: An arc welding process wherein coalescence is produced by heating with an electric arc between a tungsten electrode and the work. Shielding is obtained from helium or argon. Filler metal may or may not be used.

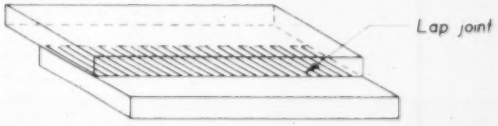
Interpass temperature: In a multiple pass weld, the lowest temperature of the deposited weld metal before the next pass is started.

Joint geometry: The shape and dimensions of a joint in cross section prior to welding.

Joint penetration: The minimum depth a groove weld extends from its face into a joint, exclusive of reinforcement.



Lap joint: A joint between two overlapping members.



Local preheating: Preheating a specific portion of a structure.

Local stress relief heat treatment: Stress relief heat treatment of a specific portion of a weldment, as done extensively with induction coils or propane gas torches in the field erection of steel piping.

Machine welding: Welding with equipment which performs the welding operation under the observation and control of an operator. The equipment may or may not perform the loading and unloading of the work.

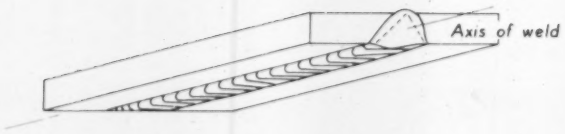
Manual welding: Welding wherein the entire welding operation is performed and controlled by hand.

Normalizing: A process in which a carbon or alloy steel is heated to a suitable temperature above the transformation range and is subsequently cooled in still air to room temperature. Hot bent 5 percent Cr — ½ Mo alloy steel pipe is frequently normalized by heating to 1650 F and holding for 1 hr per in. of wall thickness followed by cooling in still air.

Tear out along this line

HPAC DATA SHEET

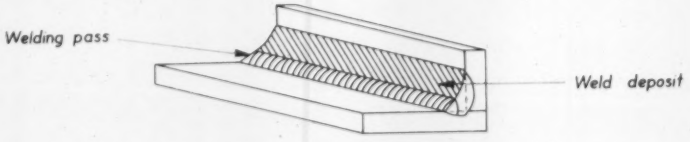
Overhead position: The position of welding wherein welding is performed from the underside of the joint.



Oxyacetylene cutting: An oxygen-cutting process wherein the severing of metals is effected by means of the chemical reaction of oxygen with the base metal at elevated temperatures, the necessary temperature being maintained by means of gas flames obtained from the combustion of acetylene with oxygen.

Oxyacetylene welding: A gas-welding process wherein coalescence is produced by heating with a gas flame or flames obtained from the combustion of acetylene with oxygen and with or without the use of filler metal.

Pass: A single longitudinal progression of a welding operation along a joint or weld deposit. The result of a pass is a weld bead.



Peening: The mechanical working of metals by means of hammer blows.

Pickle: Chemical or electrochemical removal of surface oxides. It is frequently used to remove weld discoloration on stainless steel tube and pipe sections.

Polarity: Direction of flow of current.

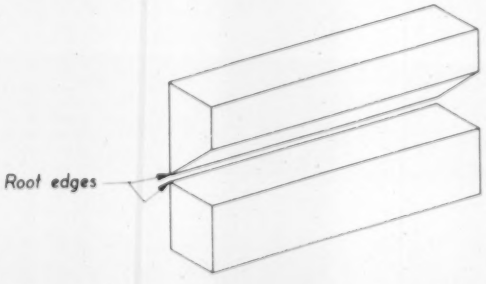
Porosity: Presence of gas pockets or voids in metal.

Positioned weld: A weld made in a joint which has been so placed as to facilitate making the weld.

Postheating: The application of heat to a fabricated or welded section subsequent to a fabricating, welding or cutting operation. Postheating may be done locally, as by induction heating, or the whole assembly may be postheated in a furnace.

Preheating: The application of heat to the base metal prior to a welding or cutting operation.

Root edge: A root face of zero width.



More pipe welding terms will be defined and illustrated in early issues. ≠

HEATING, PIPING & AIR CONDITIONING

JOURNAL SECTION

OF

AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS

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President's Message

This is the

Christmas Season

No message that I could possibly send is of importance equal to that of expressing to every member of the Society my earnest wish that he experience the joys of the Season to the fullest.

E. R. Queer

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Research on Heating and Ventilation In Relation to Human Comfort

By Thomas Bedford*, London, England

SUMMARY—Reference is made to an ionization anemometer for low air speeds, and to the globe thermometer for measuring radiant heat.

Indexes of warmth are discussed, and reference is made to the adjustment of effective temperature to allow for radiation.

With reference to comfort zones, the view is expressed that thermal conditions should be controlled within fairly narrow limits. A *comfort zone* the limits of which are those conditions at which 50 percent of people become uncomfortable is too wide.

Skin temperature has been used as an objective index of comfort, but various studies have shown that it is of dubious value for that purpose.

It is not enough merely to ensure that the effective temperature is suitable. Various other factors contribute to the pleasantness or otherwise of the environment. There should be adequate but not excessive air movement, and a suitable humidity. Cold walls make for discomfort, as do also excessive vertical gradients of air temperature.

In a room heated by ceiling panels the elevation of MRT due to the panels should not exceed 4 F deg. When floor heating is used the surface temperature of the floor must not be excessive; according to recent experiments it should not be above 77 F.

THAT THE WARMTH of man's surroundings has a profound influence on his well-being is no new idea. Before the Christian era Hippocrates wrote of the effect of climate on the physique, intelligence and temper of peoples. Modern climatologists[1,2] have studied the effects of climate on civilization. Markham holds that civilization depends to a great extent upon the control of the indoor climate in a good natural climate.

In the past half century many investigations of the effects of the thermal environment on comfort and on efficiency and general well-being have been made, and on the whole it seems reasonable to conclude that the conditions desirable for comfort are also those most conducive to efficiency.

In discussing the subject of comfort the author proposes to draw largely on the work of his associates and himself.

Thermal Measurements

First, reference is made to measurements of the thermal environment. Measurements of air temperature and humidity present no difficulty and call for no comment.

Air speed: For the measurement of air speeds the silvered kata thermometer has been relied greatly upon, but this gives only the average speed over a period of 2 or 3 min. When concerned with the variability of speed a hot-wire anemometer consisting of 3 wires in mutually perpendicular planes was used. A difficulty with many hot-wire anemometers, however, is that at low air speeds the natural convection due to the heated wire may mask the effects of the general air movement.

A few years ago, with the object of overcoming this difficulty, Dr. Lovelock[3] devised an ionization anemometer (Fig. 1) which is omnidirectional. In the original model the ionizing source was a ½-in. sphere plated with polonium. When it was later shown that particles of polonium could be dispersed through disintegration, and that they were highly toxic, it was necessary to use another source. In the modified instrument[4] the ionizing electrode is covered with radium-gold foil (radium sandwiched between 2 films of gold, backed on one side with silver foil). Thus radon is occluded and the polonium which is eventually produced is prevented from escaping. Surrounding the active sphere is a collecting cage of 3 mutually perpendicular rings of 10-cm diameter, and this is surrounded by an earthed screen. The ion current is fed to an amplifier and the anode current is calibrated in terms of air speed. The instrument can be used with an oscilloscope and camera or with a high-speed recorder, and will give full response with frequencies up to 2 cps.

Mean Radiant Temperature: The mean radiant temperature (MRT) has been measured either by scanning the surroundings with a radiometer (a Moll thermopile), or it has been computed from readings of the globe (6-in. diameter), the air temperature and the air speed[5].

The equation for the globe thermometer is

$$(t_r + 460)^4 \times 10^9 = (t_g + 460)^4 \times 10^9 + 0.103\sqrt{V}(t_g - t_a)$$

where

t_r = mean radiant temperature, Fahrenheit degrees.

*Director of the Medical Research Council's Environmental Hygiene Research Unit, London School of Hygiene and Tropical Medicine.

[1]Exponent numerals refer to References.

For presentation at the 65th Annual meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, Philadelphia, Pa., January 1959.

t_g = globe thermometer temperature, Fahrenheit degrees.
t_a = air temperature, Fahrenheit degrees.
V = air speed, feet per minute.

Either of these methods gives the MRT with reference to a point or a small sphere. The value so obtained may not represent accurately the radiation load on a standing man if the radiation is strongly directional.

Fig. 1 — The ionization anomometer

At the Royal Naval Tropical Research Unit at Singapore estimates of the MRT made from globe thermometers were compared with observations made on *metal men*. These last were rather crude effigies of men, one having a surface of polished metal and the other a black surface, so that the radiation exchanges of these roughly human shapes could be determined. The tests were made in a wind tunnel, the surfaces of which were heated, but where the radiation was by no means uniformly distributed. The MRT was maintained at or above the air temperature and at times the difference was as much as 20 F deg. Globe thermometers were placed 2 ft, 3 ft-9 in. and 5 ft-6 in. above the floor. On occasions the MRT's estimated from the globes differed from the MRT ascertained from the metal men, but when the readings of the 3 globes were averaged the MRT agreed with that obtained from the metal men to within 1 F deg.

It is well to remember that in an occupied room the MRT is affected by the presence of the occupants. The effect was noted 30 years ago by Yaglou and Drinker[6], and later the author made observations[7] in factories (1) when the operatives were at work immediately before or after the dinner interval, and (2) just after the occupants had left or before they re-entered. The increase in MRT due to the occupants varied from 1 F deg in a sparsely occupied room to 4 F deg where people sat fairly close together at rows of benches. The effect would be greater still in a crowded place of assembly.

Indexes of Warmth

Comparison of Indexes: The scale of warmth most widely known and used is effective temperature, but other scales have also been used in Great Britain. Equivalent temperature allows for the temperature and speed of the air and for radiation, but it ignores humidity and is therefore of little value at temperatures much above 70 F. For ordinary room conditions Leonard Hill advocated the *cooling power* as denoted by the dry kata thermometer. Vernon suggested that the simple reading of the globe thermometer might be a good index, since it was affected by radiation.

Many years ago the author compared these indexes in a study of the comfort of people performing light industrial operations in British factories during the heating season[7]. The comfort votes recorded were correlated with the various indexes of warmth (Table 1). The number of observations in the main series was 2571.

Some of the workers were habituated to conditions that were warm by British standards and others to cool conditions, so it was not surprising that the correlations were not very high. It was interesting that the 2 indexes that made reasonable allowance for radiation gave the highest correlations, while effective temperature was no better than the simple air temperature. At the air temperatures encountered (mean 64.4 F, s.d.* 3.7 F deg) a considerable change in humidity had very little effect on sensations of warmth, and the air speed (mean 31 fpm, s.d. 15 fpm) did not

Table 1 — Correlation of comfort votes with indexes of warmth

Comfort votes correlated with	Correlation coefficient (r
Equivalent temperature	0.52 ± 0.01
Globe thermometer reading	0.51 ± 0.01
Dry-bulb temperature	0.48 ± 0.01
Effective temperature	0.48 ± 0.01
Dry kata cooling power	− 0.43 ± 0.01

*Throughout the paper s.d. = standard deviation.

vary greatly. When later an adjustment was made to the effective temperatures to make an allowance for radiant heat the correlation with comfort votes was raised to the level of that earlier found with equivalent temperature[8].

Adjustment of Effective Temperature for Radiation: Vernon and Warner[9] used the globe thermometer reading in place of the dry-bulb temperature in determining effective temperatures, and they also adjusted the observed wet-bulb temperature so that they effectively used the true vapor pressure.

When during the war the author was asked about such a radiation adjustment he advocated the use of the globe thermometer figure, but in order to reduce complications he recommended that the observed wet-bulb temperature be used. He was convinced that any error so introduced would be slight. The effective temperature thus simply adjusted became known as *corrected effective temperature* and was adopted for use in the Royal Navy[10]. From the later information of Humphreys and his colleagues[11] the author was able to calculate that on the whole the correction seemed to work very well[12], but it was not for a few years that complete validation was given by the work of the Tropical Research Unit[13]. With various elevations of MRT the physiological reactions were closely related to the corrected effective temperature.

The improved correlation with comfort votes when the radiation correction is applied has already been referred to by the author.

Comfort Zones

From the results obtained in a study of the thermal comfort of a large number of people one can arrive at a temperature or effective temperature which represents the optimum for those people. In a study by the author of factory workers in Great Britain[7] it was determined that the optimum effective temperature for winter conditions was 61 F, and in an earlier investigation Yaglou and Drinker[6] found an optimum summer figure of 70.5 F. People vary in their thermal demands, however, and the engineer needs some margin of tolerance, so it has become the practice to specify comfort zones rather than exact optimal conditions.

There are wide divergences between the comfort zones that have been determined for various places and seasons. The differences are probably due to a variety of causes. In temperate climates habits of clothing account for considerable differences[14], and habituation or inurement to cool or warm conditions plays its part. In the tropics physiological acclimatization may also be presumed to have some effect on comfort.

For the conditions of the hot arid zones of Australia, Drysdale[15] concludes that while people may prefer an air temperature of 75 F, they become accustomed to a feeling of heat and do not feel really uncomfortable until temperature approaches 84 F.

Ellis[16] studied the comfort of Europeans and Asians living in Singapore. Accepting votes of *comfortable, comfortably warm* and *comfortably cool* as signifying reasonable comfort, the comfort zones in terms of effective temperature were:

European men	73 to 79 F
European women	72 to 78 F
Asian men	71 to 81 F
Asian women	76 to 80 F

The upper limits of these zones represented air temperatures of 82 to 85 F, which agree closely with Drysdale's figure of 84 F for Australia. In a personal communication Col. N. N. Chopra, of the Indian Army, informed the author that from results obtained in offices in Delhi during the hot months the comfort zone in terms of corrected effective temperature agreed closely with the zones found by Ellis in the humid climate of Singapore.

The criteria on which the limits of the comfort zone are decided are of basic importance. Many of the zones that have been published in the past are those within which at least 50 percent of the votes have been *comfortable, comfortably cool* or *comfortably warm;* presumably all the votes which have not denoted actual discomfort. That means that at the limits of the comfort zone there is an even chance that discomfort will be experienced. It is suggested by the author that such a range is too wide, for a room can scarcely be called comfortable if nearly half the occupants are uncomfortable. In an earlier work by the author he computed comfort zones on a similar basis, and was alarmed to find that in terms of effective temperature the zone covered a range of 14 F deg. Scrutiny of the frequency distributions showed that over the range of conditions in which at least 70 percent of comfort votes were exactly *comfortable*, at least 86 percent ranged from *comfortably cool* to *comfortably warm*, and the author adopted that as the basis of the comfort zones which he recommended. Within those zones not more than 1 person out of 6 would feel any discomfort.

It is notoriously difficult to please everybody all the time, and the literature on comfort contains many amusing examples. Nearly a century ago Morin[17] bemoaned such *prejudices* and said that the only way of overcoming them was by the strict observance of well-made regulations. There will probably be wide agreement with this statement provided the regulations are based on an understanding of human requirements.

Leopold[18] has referred to the close tolerance that may be necessary to satisfy a group of people, even though the individual tolerances may be wide. A few years ago the author had outstanding confirmation of such a need. On account of complaints by members of Parliament he was asked to examine the heating and air-conditioning installation of the rebuilt

House of Commons. From a record of complaints it became evident that whatever the tolerances of individual members it was necessary to control the temperature within very narrow limits. Accordingly, the author recommended that during ordinary sittings, when the House was not densely occupied, the temperature should be maintained at 67 to 68 F, that during late sittings the temperature should be 1 or 2 F deg higher, and that when the House was crowded the temperature should be reduced by 2 or 3 F deg. Since the temperature has been maintained within narrower limits complaints have been far less frequent.

Leopold advocated the use of discomfort curves rather than graphs showing the proportions of persons who are comfortable. The author entirely agrees with him. Members of the author's Unit nowadays pay much attention to the probable incidence of discomfort under various conditions.

Skin Temperature and Comfort

It was probably variations between individuals that prompted the physiologist, Rubner[19], to remark when discussing clothing that it is a mistake to rely on personal feelings of comfort, for, he said, the feeling of comfort is in many people obtuse, undeveloped and variable. In the early years of this century Rubner's disciples[20] were using measurements of skin temperature as indexes of the effects of the thermal environment on comfort. Later, in the United States, Ward[21], observing herself and 4 others, found a close association between skin temperature and comfort votes, and it seemed that by making a series of observations on a given person in equilibrium conditions one could so *calibrate* him that his subjective feeling of warmth could be assessed with reasonable accuracy. But it did not follow that when observations were made on a large number of people it would be possible to estimate the feeling of warmth of any individual with useful accuracy.

This point was explored in the author's observations of factory workers. Skin temperatures were measured on the forehead, the palm of one hand, and on the inner aspect of one foot, and at the same time comfort votes were obtained and environmental measurements were made. When from about 2500 sets of observations partial correlations of warmth sensations with the different skin temperatures were calculated the total correlation, R, of sensations with the 3 skin temperatures was 0.44, which was lower than the correlation between sensations and either effective temperature or dry-bulb temperature. The root-mean-square error of estimation of comfort votes from the 3 skin temperatures was 0.77 of a unit on the author's scale, so that a person estimated to be exactly comfortable might be feeling too warm or too cool. The predictions were of no practical value, and individual comfort votes could be foretold with slightly greater accuracy from a knowledge simply of the room temperature.

More recently, in work sponsored by the Society[22], comfort votes were more closely correlated with effective temperature or dry-bulb temperature than with the mean skin temperature.

It is probably true that of the various physiological responses to changes in the thermal environment skin temperature is the best index of subjective feelings of comfort so long as gross discomfort is not experienced. But people vary in their demands. Thus, the optimum forehead temperature for my subjects was 93.7 F, yet in 692 observations in which the forehead temperature lay between 93.0 and 93.9 F 72.1 percent of the comfort votes were *comfortable*, 15.2 percent *comfortably warm* or *comfortably cool*, 10.8 percent *too warm* or *too cool*, and 1.9 percent *much too warm* or *much too cool*. Such individual variations seem to make skin temperature of dubious value as an index of comfort, even though it gives interesting physiological information.

Pleasant Environments

The maintenance of the desired effective temperature does not necessarily ensure that the environment will be a pleasant one. Attention must also be paid to the distribution of heat and to the individual factors that make up the thermal environment. Forty years ago Sir Leonard Hill[23] emphasized the importance of adequate and variable air movement, some variability of temperature, and a relatively dry atmosphere. Hill's teaching was based largely on the study of outdoor conditions, and later Dr. Vernon, Dr. Warner and the author[24,25,8] investigated the effects of these factors on indoor comfort. Temperature, humidity, mean air speed, and variability of air speed were measured and at the same time impressions were noted of freshness or stuffiness on a 9-point scale. Excessive temperature or humidity, inadequate speed and uniformity of speed gave rise to feelings of stuffiness, while within limits cool, dry and moving air felt fresh and pleasant.

Air Movement: At a temperature of 65 F or so if the air speed is less than about 15 fpm the atmosphere is likely to feel stuffy, but complaints of draft may arise with speeds in excess of 40 or 50 fpm. Baetjer[26] found that at such a temperature air movement was not perceptible at less than 40 fpm, and it seems that at ordinary room temperatures perceptible air movement may evoke complaints, but that movement which is below the threshold of perception can exert a beneficial effect. In a hot environment just-perceptible movement (120 fpm at 86 F) may not cause complaint, but sedentary people may well dislike much higher speeds.

In the study by Dr. Vernon, Dr. Warner and the author, the variability of air speed was ascertained by

making observations at 2- or 2½-sec intervals over a period of 5 min, and the mean variation of speed was expressed as a percentage of the average speed. In a series of observations when the average air temperature was 71 F, and the average air speed 45 fpm, when temperature and average speed were held constant there remained a highly significant partial correlation between variability of speed and impressions of freshness ($r = 0.43 \pm 0.08$). The average value of this mean variation was 33 percent with a standard deviation of 10.6 percent. It appeared that an increase of 3 percent in the mean variation of speed had about the same effect on subjective impressions as a decrease of 1 F deg in the air temperature. The changes in air speed were random.

Recently, Dr. Turner[27] studied the effects of mild currents of air impinging on the face. In calm air at 66 F a sudden increase of speed from 12 to 30 fpm was enough to produce a just-perceptible feeling of coolness. From earlier observations it can be calculated that if at that temperature the air speed alternated suddenly and with random frequency between 12 and 30 fpm, giving an average of 21 fpm and a mean variation of 43 percent, the subjects would have found the air rather fresh, whereas if with the same average speed the mean variation were reduced to 20 percent, say, by alternations of speed between 17 and 25 fpm, they would have had a preference for more stimulating conditions.

Fig. 2 shows the air speeds observed in an office on a June day when the indoor air temperature was 67 F. Curve (a) is a record from the main office ventilated by open windows. The mean speed was 23 fpm with a mean variation of 5.8 fpm. Curve (b) shows the speeds in a small office partitioned off from the rest of the room. The average speed was 12 fpm, with a mean variation of only 2.7 fpm. In the first position the subjects found the conditions neither stuffy nor particularly fresh, but in the second the air felt stuffy and completely stagnant.

Humidity: At room temperatures met with in Great Britain in winter the effect of humidity on the feeling of warmth is small[7], but there is evidence that changes in humidity which have no appreciable effect on feelings of warmth may yet affect the pleasantness of the environment[28,29].

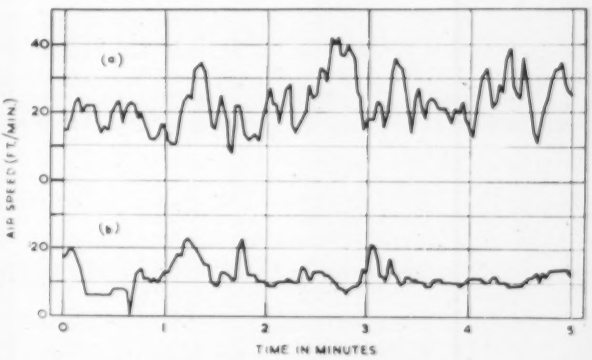

Fig. 2 — Hot-wire anemometer records showing variability of air speed

There was a significant correlation between relative humidity and impressions of freshness when effective temperature was held constant, so that at a given effective temperature one had a feeling of greater freshness at the lower humidities. It is the author's general impression that from the standpoint of comfort a humidity much above 60 percent is undesirable. Very low humidities also are undesirable, but no discomfort at temperatures of 65 to 70 F was felt when the humidity has been about 30 percent.

Warm walls: A century ago some Commissioners appointed by the General Board of Health in England to inquire into the warming and ventilating of dwellings[30] put down as one of the desiderata for comfort that the walls of a room should be at least as warm as the air, and they included cold walls or floors among the conditions that make for discomfort. Although there was no experimental evidence, Dr. Warner and the author were convinced that the Commissioners were right, for on various occasions feelings of stuffiness were experienced when the only possible explanation seemed to be the fact that the MRT was 6 F deg or more below the air temperature.

Later, the author's colleagues[31] studied the reactions of 145 subjects, each of whom was exposed 3 times to a given equivalent temperature (60, 65 or 70 F), once with the boundary surfaces of the room at air temperature, once with the surface temperature 5 F deg below, and once with it 3 F deg above air temperature. The surfaces were maintained substantially at a uniform temperature.

Of those subjects who were exposed to equivalent temperatures of 65 or 70 F, 83 or 84 percent found the warm-wall condition more pleasant than the cold-wall. The warm-wall situation felt distinctly fresher than either of the others, and in the cold-wall condition they felt rather less fresh than when walls and air were at the same temperature. Munro and Chrenko suggested that the greater freshness found with warm walls was due to transient fluctuations in the rate of heat loss from the nasal membranes, for when the walls were warm the air temperature was correspondingly lower and the vapor pressure somewhat lower.

Thermal Gradients: In 1857 it was said[30] that for comfort the floor should be at the highest temperature in the room, while the temperature should gradually decrease toward the ceiling. Little attention seems to have been given to this recommendation; and many heating installations create considerable temperature gradients between floor and ceiling. With such gradients the feet tend to be cool and the head overheated, and even if the head does not feel too warm there is liable to be discomfort which is hard to describe.

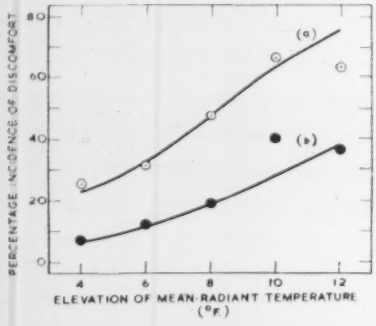

Fig. 3 — Percentage frequency of discomfort in relation to elevation of MRT (a) feelings of unpleasantness, (b) uncomfortable warmth of the head

In factories the air at head level has often been found to be several degrees, sometimes 10 or 11 F deg, warmer than that near the floor, and with such gradients there have been regularly experienced feelings of stuffiness and the conditions found to be unpleasant. When the gradient over the height of a man has been no more than 2 or 3 F deg one has been very comfortable. Although the author's opinion is based on general observation over many years rather than on critical experiments, he is convinced that the gradient from floor to head level should not exceed 5 F deg, and should preferably be less.

Excessive thermal gradients due to radiant heat are also undesirable. Although an MRT somewhat higher than the air temperature is conducive to comfort when the boundary surfaces are uniformly warm, if the elevated MRT is achieved by local radiation directed toward the head serious discomfort may arise. This is of importance in connection with ceiling heating.

Ceiling Heating

Chrenko[32] has reported the results of intensive experiments on 5 subjects and of further experiments on a group of 150 subjects. The 5 subjects were exposed to the radiation from a warmed panel (6 ft x 4 ft) or from the whole of a movable ceiling (12 x 18 ft), at different temperatures and different heights, and the larger group to the warmed ceiling at a height of 8½ ft, but with varying temperatures. The air temperature averaged 66 F and the air speed did not exceed 20 fpm.

The subjects reported on their overall state of warmth, and they were also questioned as to their local sensations referred to their heads and their feet. Finally they were asked to say whether the environment was pleasant or not, and to give reasons if it was unpleasant.

The incidence of discomfort was more closely associated with the elevation of MRT at head level due to the overhead radiation (*i.e.*, the actual MRT *minus* the *unheated* MRT) than to the intensity of the radiation incident on either the forehead or the top of the head.

Fig. 3 shows the results obtained with the group of 150 subjects (441 experiments). The upper curve shows the percentage frequency of complaints of unpleasantness, and the lower one the frequency of uncomfortable warming of the head. Complaints of unpleasantness occurred about twice as frequently as complaints that the subjects' heads were uncomfortably warm.

Subjects who complained of unpleasantness described one or more symptoms to account for their complaints, and an attempt was made to classify these (Table 2).

Nearly 90 percent of the symptoms related to the head or to gradients of sensation. These gradients of sensation which comprised 24 percent of the symptoms were discussed by Chrenko, who considered that tolerance of a warmed ceiling might well be increased if the floor were also warmed.

Although the average air temperature in these experiments was about 66 F there was some variation between experiments and on some occasions the temperature was as low as 64 F and on others rather more than 70 F. Statistical examination of the results showed that when the elevation of MRT was held constant there was a low but significant partial correlation between air temperature and sensations of warmth of the head. This indicates that at the higher air temperatures tolerance of the radiation from a warmed ceiling declines.

Table 2 — Frequency of occurrence of various symptoms associated with feelings of unpleasantness due to radiation from overhead

Symptom	Percent of all symptoms
Warmth on the head	41
Effects on the eyes	5
Other effects on the head	19
Gradients of sensation, *e.g.*, warmth of the head while the feet were chilly	24
Stuffiness	5
General thermal discomfort	6

From his results Chrenko concluded that under the conditions in which ceiling heating is used in Great Britain the elevation of MRT due to the heated ceiling should not exceed 4 F.

Floor Heating

The ancient Greeks, and then the Romans, heated the floors of their buildings by means of the hypocaust. In modern times a notable example of floor heating is that of Liverpool Cathedral. Just after World War I schools in Derbyshire were heated by means of warmed floors, and many observations were made in those schools[33]. Commonly the surface temperature of the floor did not exceed 75 F, and the observers were very comfortable, but when occasionally the surface temperature reached or exceeded 80 F they found the floor very tiring for the feet.

Since that time floor heating has been used in many commercial buildings, and also in dwellings. Various opinions were expressed as to the maximum desirable temperature of a warmed floor, but there was little or no experimental evidence. At a conference in Paris[34] the author expressed the view that the maximum desirable temperature was 75 F or perhaps 77 F, Liese (Germany) agreed with 77 F, while Missenard (France) and Squassi (Italy) allowed 82.5 F. From experiments, Herrington and Lorenzi concluded that floor temperatures above 75 F were undesirable and that the local effect was clearly demonstrable at 80 F.

Chrenko[35] has reported laboratory experiments made on men and women subjects wearing their normal footwear who in different experiments (1) sat with their feet on a heated floor, or (2) walked about on it. The air temperature in individual experiments ranged between 58 and 76 F, averaging 68 F. The subjects were questioned as to their state of general bodily warmth and they also reported their sensations of warmth of the feet.

Skin temperatures were measured on the ankle, on the sole of the foot at the base of the big toe, and on the dorsal surface of the big toe. The temperature most closely associated with local sensations was that measured on the sole.

For all 4 sets of observations, women sitting or walking and men sitting or walking, the relations between skin temperature of the sole and local sensations were so similar that it was justifiable to group the results. For the grouped results (801 experiments) the correlation coefficient was + 0.72 ($P<0.001$).

Fig. 4 shows the relation between the incidence of discomfort and the skin temperature of the sole of the foot. Some subjects felt discomfort when the skin temperature exceeded 86 F, and when it reached 93½ F, 50 percent were uncomfortable.

Local skin temperature is influenced by the general thermal state of the body as well as by local exposures, so that the temperature of the sole of the foot is affected by the air temperature as well as the temperature of the floor. Regression equations in which t_s is the skin temperature of the sole, t_a the air temperature, and t_f the floor temperature (all in F deg) for the 4 groups were:

Women sitting:	$t_s = 0.494t_a + 0.351t_f + 25.7$
Women walking:	$t_s = 0.451t_a + 0.488t_f + 18.1$
Men sitting:	$t_s = 0.603t_a + 0.379t_f + 14.8$
Men walking:	$t_s = 0.280t_a + 0.813t_f + 0.5$

The regression constants are subject to some error and the actual values should not be stressed too greatly. It is significant, however, that when the subjects walked and thus made firmer contact with the floor the effect of floor temperature was greater than when they sat.

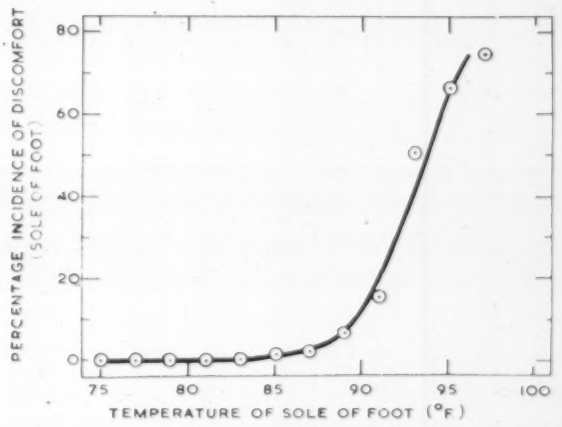

Fig. 4 — Percentage incidence of uncomfortable warming of the feet after 60 min exposure to heated floor

The highest floor temperature at which no discomfort was experienced was 77 F. At the room temperatures commonly maintained in Great Britain considerable warming can be achieved with such a floor temperature, which, according to these results, is unlikely to occasion even mild discomfort.

The skin temperature on the sole of the foot was affected by the air temperature as well as the floor temperature. In the sitting subjects, both men and women, a change of 1 F deg in the air temperature had a greater effect than a similar change in the temperature of the floor, but when the subjects were walking the floor temperature exerted the greater effect. This effect of air temperature shows that a floor that would be uncomfortably warm in a room heated to one temperature might be quite acceptable in a cooler room.

Nevins and Flinner[36] have reported experiments in which they found no significant correlation between comfort votes and the tempera-

ture of the floor. The comfort votes presumably related to general bodily warmth, and in that event the lack of correlation is not suprising. Mr. Chrenko informed the author that out of 666 experiments in which, apart from local sensations referred to the soles of the feet, the subjects were otherwise quite *comfortable*, in 21.5 percent instances the feet were uncomfortably warm, and in a further 56 percent the feet were said to be *comfortably warm, i.e.*, while these subjects did not suffer actual discomfort they would have preferred their feet to be somewhat cooler. This local discomfort when conditions are otherwise satisfactory is similar to what the author encountered many years ago in connection with gradients of air temperature[7], when factory workers complained that their feet were cold but insisted that they would not like the general temperature of the workroom to be any higher.

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Downward Heat Transfer through a Joist Space

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SUMMARY. This paper is a result of a theoretical study on the mode of downward heat transfer through a joist space without conductive insulating materials. It is shown that the radiation between the surface surrounding the air space creates a convection current. Equations are derived from the boundary layer considerations which enable one to calculate the heat transfer between the surrounding surfaces and the air.

Simultaneous solution of the convection equation, the rational radiation equation, and the conduction equation for the joist yielded an overall heat transfer through a typical joist space. Typical values thus calculated are compared to experimental data and also to results calculated by the conventional method[1]. The limited comparison shows that the present method (reported here) agrees more closely with the experimental results than the conventional method. Design curves are constructed from the present calculations for 3 different inner surface conditions.

THE EXISTING, or conventional, method[1] of evaluating total heat transfer through a joist space, without insulating materials, starts with the following separate calculations.

1. Conduction and convection through the air space (obtainable by experiments only).
2. Radiation between the upper and the lower plates with the assumption that they are infinite parallel plates (joists are completely ignored in the radiation consideration).
3. Conduction through the joists assuming a linear temperature variation along the surface.

The total heat transfer through the joist space is then obtained by summing up these 3 values. Extensive experiments at the University of Minnesota have shown that often this conventional method of calculation does not yield heat transfer values with adequate accuracy.

In this paper, a theoretical study is made of the mode of heat transfer downward through a typical joist space. The theoretical work is then compared to some of the pertinent experimental data.

Convection in the Joist Space

In heat transfer down through a joist space, no natural convection of air is possible when the temperature varies linearly along the joist surface from the upper plate to the lower plate. The mode of heat transfer, then, is by radiation and conduction only.

Usually, however, the radiation heat exchange between the joist surfaces (c in Fig. 1), and the other 2 surfaces (a & b in Fig. 1), causes the temperature variation along the joist to deviate from the linear variation. This creates horizontal temperature differences between the joist surface and the air. The adjacent air is then heated by the joist and rises along its surface. Upon reaching the upper plate, the air stream continues its movement along this plate horizontally toward the middle of the joist space. At midway, the stream meets the counter stream created by the other joist. The 2 streams merge and descend toward the lower plate.

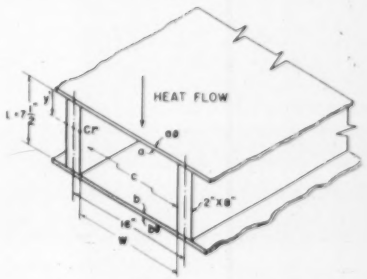

Fig. 1 — Diagram of the joist space studied

The overall picture is represented in Fig. 2. Fig. 3 shows an enlarged portion of the joist space and the general shape of the velocity and the temperature profile through the boundary layer.

The simplified theoretical model shown on Fig. 4, is assumed here in order to solve the complicated problem shown on Figs. 2 and 3. In Fig. 4, L represents the joist and $W/2$ represents half of the upper plate. Therefore, in the theoretical study, the effect of turning the boundary layer at the upper corner is discarded. This is justified because since

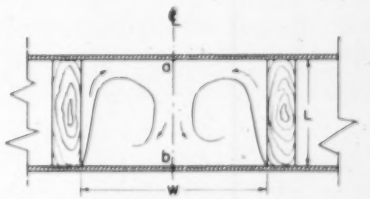

Fig. 2 — Representation of air currents in the joist space

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[1]Exponent numerals refer to References.

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the velocities involved in the boundary layer are small, the turning does not distort the velocity and the temperature profiles to any degree.

The surface temperature of the joist is assumed to be uniform at the average temperature, T_c.

T_c usually rises above T_o due to the radiation heat exchange. T_o represents the temperature of the air outside the boundary layer. The actual magnitude of T_c depends largely on the radiation itself which, in turn, is a function of the shape factors, surface emissivities, and T_a and T_b.

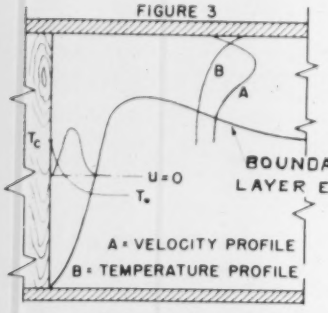

Fig. 3 *(above)* — Enlarged portion of joist space showing general shape of velocity and temperature profiles through the boundary layer

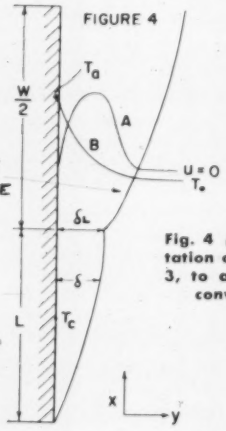

Fig. 4 *(left)* — Representation of the curves of Fig. 3, to assist in solution of convection problem

This excess temperature of T_c above T_o acts as a driving force, and a natural convection boundary layer is built up along the joist surface. After the air stream reaches $x = L$, the upward driving force disappears since the actual direction of the stream is horizontal for $x > L$ (Figs. 2 and 4). However, for $x > L$, the air within the boundary layer still possesses momentum. This momentum was imparted to the air previously while it was traveling along the joist surface. The velocities of the air in the boundary layer decrease continuously for $x > L$ because of the drag at the solid surface and the continuous increase in the thickness of the boundary layer.

The heat transfer between the joist and the air can be obtained from the existing solution of the natural convection boundary layer equations for a vertical heated surface.

Integral Equations 1 and 2 of momentum and thermal boundary layers are derived in Reference 2.

$$\frac{d}{dx}\int_0^{l_m} u^2 dy = g\beta\int_0^{l_m} D\,dy - \nu\left(\frac{du}{dy}\right)_0 \quad \text{.....(1)}$$

$$\text{and} \quad \frac{d}{dx}\int_0^{l_t} uD\,dy = -\alpha\left(\frac{dD}{dy}\right)_0 \quad \text{.....(2)}$$

In the solution of Equations 1 and 2, the temperature and velocity profiles are usually approximated by the parabolas of Equations 3 and 4.

$$D = \theta\left(1-\frac{y}{\delta}\right)^2 \quad \text{.....(3)}$$

$$u = U_1\frac{y}{\delta}\left(1-\frac{y}{\delta}\right)^2, \text{ where } \delta = l_m = l_t^* \quad \text{.....(4)}$$

Solution of Equations 1 and 2 yields Equations 5 and 6.

$$\delta = 3.93\,Pr^{-1/4}(0.952+Pr)^{1/4}\left(\frac{g\beta\theta}{\nu^2}\right)^{-1/4}x^{1/4} \quad \text{.....(5)}$$

$$U_1 = 5.17\,\nu\left(\frac{20}{21}+Pr\right)^{-1/2}\left(\frac{g\beta\theta}{\nu^2}\right)^{1/2}x^{1/2} \quad \text{.....(6)}$$

It was shown in reference (2) that

$$H_c = \frac{4}{3}\left(\frac{2K}{\delta_L}\right) \quad \text{.....(7)}$$

Detailed derivations of Equations 1 through 7 are given in Reference 2.

The heat transfer from the joist to the air, q_c, is then obtained by Equation 8.

$$q_c = H_c A_c (T_c - T_o) = H_c A_c \theta \quad \text{.....(8)}$$

The solution of heat transfer for $x > L$ is attempted here using the following procedure.

The momentum equation in the absence of the driving force becomes:

$$\frac{d}{dx}\int_0^{l_m} u^2 dy = -\nu\left(\frac{du}{dy}\right)_0 \quad \text{.....(9)}$$

The thermal boundary layer equation is unchanged from Equation 2.

A substitution of Equations 3 and 4 into Equations 9 and 2 yields Equations 10 and 11.

$$1/105\; d/dX\;(U_1^2\,\delta) = -\nu\,U_1/\delta \quad \text{.....(10)}$$

$$1/30\; d/dX\;(U_1\,\delta) = 2\alpha/\delta \quad \text{.....(11)}$$

Equations 10 and 11 are combined to yield Equation 12.

$$\delta^2\; dU_1/dX = -105\;\nu - 60\;\alpha \quad \text{.....(12)}$$

Let

$$Z = \delta^2$$

and

$$n_1 = -105\;\nu - 60\;\alpha$$

Then Equation 12 becomes:

$$Z\; dU_1/dX = n_1 \quad \text{.....(13)}$$

Equation 11 may be transformed to the following equation:

$$\delta^2\frac{dU_1}{dx} + \frac{1}{2}U_1\frac{d\delta^2}{dx} = 60\alpha.$$ *With the aid of Equation 13, this becomes:*

$$n_1 + \frac{1}{2}U_1\frac{dZ}{dx} = 60\alpha \quad \text{.....(14)}$$

Let $n_2 = 240\alpha + 210\nu$, then Equation 14 becomes:

$$U_1\; dZ/dX = n_2 \quad \text{.....(15)}$$

Now the problem is to solve the 2 Equations 13 and 15 simultaneously.

Dividing Equation 15 by Equation 13 yields:

$$dZ/Z = n_2/n_1\; dU_1/U_1$$

This is integrated between the limits of $x = L$ to any other $x > L$ as follows:

$$\int_{Z_L}^{Z}\frac{dZ}{Z} = \frac{n_2}{n_1}\int_{U_{1L}}^{U_1}\frac{dU_1}{U_1}, \text{ and } Z = Z_L\left(\frac{U_1}{U_{1L}}\right)^{\frac{n_2}{n_1}} \quad \text{.....(16)}$$

*$l_m = l_t$ is a popular accepted assumption for the natural convection analysis.

Differentiate Equation 16 with respect to x, and make a substitution from Equation 15.

$$\text{Then: } (U_1)^{\frac{n_2}{n_1}} dU_1 = \frac{n_1}{Z_L}(U_{1L})^{\frac{n_2}{n_1}} dx \qquad (17)$$

This again is integrated between the limits of $x = L$ to any other $x > L$.

$$\text{Then: } (U_1) = \left[(U_{1L})^{\frac{n_2}{n_1}}\left(\frac{n_1+n_2}{Z_L}x' + U_{1L}\right)\right]^{\frac{n_1}{n_1+n_2}} \qquad (18)$$

where: $x' = x - L$. Finally, from Equation 16:

$$\delta = \delta_L\left[\frac{n_1+n_2}{Z_L U_{1L}}x' + 1\right]^{\frac{n_2}{2(n_1+n_2)}} \qquad (19)$$

δ_L and U_{1L} can be obtained from Equations 5 and 6 by putting $x = L$. Equation 19 then gives the thickness of the boundary layer, δ, for any x'. The local heat transfer coefficient for the upper plate, h_a, from the boundary layer solution is $2K/\delta$. Therefore h_a can be obtained from Equation 19.

The total heat transfer from the upper plate is finally obtained by the following integration:

$$q_a = 2(T_a - T_o)\int_0^{\frac{W}{2}} h_a\, dx' \qquad (20)$$

The heat transfer coefficient between the lower plate and the air cannot be obtained so easily because the behavior of the air streams after merging is unknown.

After studying the physical conditions involved, it was decided to assume that $h_b = h_a$ for the present analysis. The close agreement of the calculated values to the experimental results, seen later, would also justify this assumption.

Radiation and Conduction through the Joist

As stated earlier in this paper the conventional way of evaluating the radiation is to consider that the plates a and b are infinite in size to neglect the effect of the joists on radiation completely. It was stated[1] that this assumption did not introduce any sizable error. This is true if it is also assured that the temperature variation through the joists is unaffected by radiation and is always linear.

Experimental results at the University of Minnesota have shown that this assumption may lead to considerable discrepancy in the evaluation of the total conductance of the joist space. This is because the temperature gradient through the joist affects the conduction through the joists themselves and the convection as well as the radiation between the joist and the surfaces a and b.

Hottel[2] gave Equation 21 for the radiation shape factor between 2 plates such as a and b shown in Fig. 1.

$$F_{ab} = \frac{L}{W} + \sqrt{1 + \left(\frac{L}{W}\right)^2} \qquad (21)$$

Then, by the reciprocity theorem; $F_{ba} = F_{ab}$; $F_{ac} = F_{bc} = 1 - F_{ab}$; $F_{ca} = F_{cb} = A_a/A_c\, F_{ac}$; and $F_{cc} = 1 - 2F_{ca}$.

Rational radiation equations for the net heat transfer between the surfaces a and b, a and c, and c and b, are as follows:†

$$q_{ab} = 0.173\, e_a e_b A_a S_2 S_3 S_4 \left[F_{ab} + (1-e_c)F_{ac}F_{cb}S_1\right]\left[\left(\frac{T_a}{100}\right)^4 - \left(\frac{T_b}{100}\right)^4\right] \qquad (22)$$

where: $S_1 = \dfrac{1}{1-F_{cc}(1-e_c)}$; and

$S_2 = \dfrac{1}{1-(1-e_a)(1-e_c)F_{ac}F_{ca}S_1}$, and

$S_3 = \dfrac{1}{1-(1-e_b)(1-e_c)F_{bc}F_{cb}S_1}$, and

$S_4 = 1\Big/\Big\{1-(1-e_a)(1-e_b)S_2S_3\left[F_{ba} + (1-e_c)F_{bc}F_{ca}S_1\right]\left[F_{ab} + (1-e_c)F_{ac}F_{cb}S_1\right]\Big\}$

†See Reference 3 for the detailed derivation of the radiation equations.

Nomenclature

A_a = inside surface area of upper plate per foot of joist section length, square feet.
A_b = inside surface area of lower plate per foot of joist section length, square feet.
A_c = surface area of joist per foot of joist section length (2L for a section), square feet.
A_w = horizontal cross-sectional area of joist, per foot of joist section length, square feet.
β = coefficient of thermal expansion for air.
D = difference in temperature at any point within the boundary layer and the temperature outside of it = $(T - T_o)$, Equations 1, 2 and 3.
δ = thickness of boundary layer in general, feet.
σ_L = thickness of boundary layer at $x = L$, feet.
Δt = $T_a - T_b$.
e = emissivity.
E = heat transfer by conduction through joist, per foot of joist section length Btu per (hour).
F = radiation shape factor.
g = 32.2 feet per (second) (second).
h_a = local convective heat transfer coefficient for surface a, Btu per (hour) (square foot) (Fahrenheit degree).
h_b = local convective heat transfer coefficient for surface b, Btu per (hour) (square foot) (Fahrenheit degree).
H_c = average convective heat transfer coefficient for surface c, Btu per (hour) (square foot) (Fahrenheit degree).
K = thermal conductivity of air, Btu per (hour) (foot) (Fahrenheit degree).
K_w = thermal conductivity of joist material, Btu per (hour) (foot) (Fahrenheit degree).
a = thermal diffusivity of air.
l_m = thickness of momentum boundary layer, feet.
l_t = thickness of thermal boundary layer, feet.
L = depth of the joist space defined in Fig. 1, feet.
ν = kinematic viscosity of air, square feet per hour.
n_1 = $.105\nu - .60a$, Equation 13 and following.
n_2 = $240a + 210\nu$, Equation 13 and following.
Pr = Prandtl number.
q_a = heat transfer from surface a to air by convection, per foot of joist section length, Btu per hour.
q_b = heat transfer from air to surface b by convection per foot of joist section length, Btu per hour.
q_c = heat transfer from joist to air by convection per foot of joist section length, Btu per hour.
q_{ab} = heat transfer from surface a to surface b by radiation per foot of joist section length, Btu per hour.
q_{ac} = heat transfer from surface a to surface c by radiation per foot of joist section length, Btu per hour.
q_{cb} = heat transfer from surface c to surface b by radiation per foot of joist section length, Btu per hour.
T = Rankine temperature unless specified otherwise.
T_a = surface temperature of the upper plate, Rankine degrees.
T_b = surface temperature of the lower plate, Rankine degrees.
T_c = average surface temperature of joist used in convection analysis, Rankine degrees.
T_o = temperature of air outside boundary layer, Rankine degrees.
u = $T_o - T_w$.
u = velocity in direction parallel to solid surface, feet per hour.
U_1 = a function of x defined in Equation 4.
W = width of the joist space defined in Fig. 1, feet.
x, y = directions and distances defined in Fig. 4.
x' = distance defined in Fig. 1, feet.
Z = $\frac{K^2}{\nu}$, Equation 12 and following, square feet.

Subscripts

a, b, c = surfaces defined in Fig. 1.
ab, ac, cb = a to b, a to c, c to b respectively.
ao, bo = surfaces defined in Fig. 1.
cr = a point on joist surface at a distance 2/3 L down from upper plate.
L = $(x = L)$
o = condition at the solid boundary, $(y = 0)$.

$$q_a = 0.173 e_a e_c A_a S_2' S_3' S_4' [F_{ac} + (1-e_b) F_{ab} F_{bc}] \left[\left(\frac{T_a}{100}\right)^4 - \left(\frac{T_{cr}}{100}\right)^4\right] \quad (23)$$

where: $S_2' = \frac{1}{1-(1-e_a)(1-e_b)F_{ab}F_{ba}}$; and

$S_3' = \frac{1}{1-(1-e_c)(1-e_b)F_{cb}F_{bc}}$; and

$S_4' = 1/\{1-(1-e_a)(1-e_c)S_2'S_3' [F_{ca}+(1-e_b)F_{cb}F_{ba}] [F_{ac}+(1-e_b)F_{ab}F_{bc}]\}$

$$q_{cb} = 0.173 e_c e_b A_a S_2'' S_3'' S_4'' [F_{bc} + (1-e_a) F_{ba} F_{ac}] \left[\left(\frac{T_{cr}}{100}\right)^4 - \left(\frac{T_b}{100}\right)^4\right] \quad (24)$$

where: $S_2'' = \frac{1}{1-(1-e_a)(1-e_a)F_{ba}F_{ab}}$; and

$S_3'' = \frac{1}{1-(1-e_c)(1-e_a)F_{ca}F_{ac}}$; and

$S_4'' = 1/\{1-(1-e_b)(1-e_c)S_2''S_3'' [F_{cb}+(1-e_a)F_{ca}F_{ab}] [F_{bc}+(1-e_a)F_{ba}F_{ac}]\}$

The temperature and the shape factors along the joist surface vary non-linearly from the upper plate to the lower plate. The radiation Equations 22 through 24 were developed for the representative surface temperature T_{cr} and with the overall shape factors between the joist and the surfaces a and b. The question here is: "Which point along the joist surface does T_{cr} represent?"

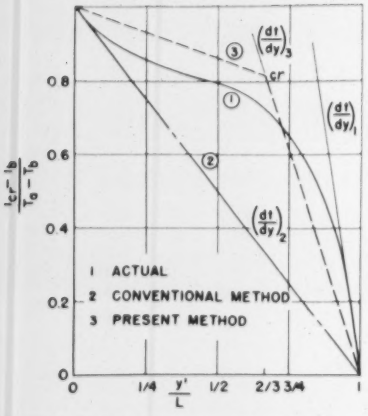

Fig. 5 — Typical temperature distribution along the joist surface

Let y' indicate the distance along the joist surface from the upper plate to the point where the temperature is at T_{cr} (see Fig. 1). Then, in the heat balance (next section), the following simple equations will be used to calculate the conduction through the joist.

$$E_{ac} = K_w A_w (T_a - T_{cr})/y' \quad \ldots (25)$$

$$E_{cb} = K_w A_w (T_{cr} - T_b)/(L - y') \quad \ldots (26)$$

It is known from the experiments that usually the temperature varies along the joist surface in the general manner shown in Fig. 5. Through much analysis with the equations previously developed, it was found that the best approximation to the actual temperature variation along the joist surface is obtained by letting $y' = 2/3\ L$.

The heat transfer from the upper plate to the lower plate by the conduction through the joist is actually (See Fig. 5) given by Equation 27.

$$E_{ab}\ (\text{Actual}) = K_w A_w \left(\frac{dt}{dy}\right)_1 \quad \ldots (27)$$

whereas that calculated by the conventional method is as stated by Equation 28.

$$E_{ab}\left(\frac{\text{Conventional}}{\text{method}}\right) = K_w A_w \left(\frac{dt}{dy}\right)_2 = K_w A_w \frac{T_a - T_b}{L} \quad (28)$$

and that calculated by the present method is stated by Equation 29.

$$E_{ab}\left(\frac{\text{Present}}{\text{method}}\right) = K_w A_w \left(\frac{dt}{dy}\right)_3 = K_w A_w 3 \frac{T_{cr} - T_b}{L} \quad (29)$$

Comparison of the equations in light of Fig. 5 illustrates the improvement of the present method over the conventional one in the calculation of the conduction through the joist.

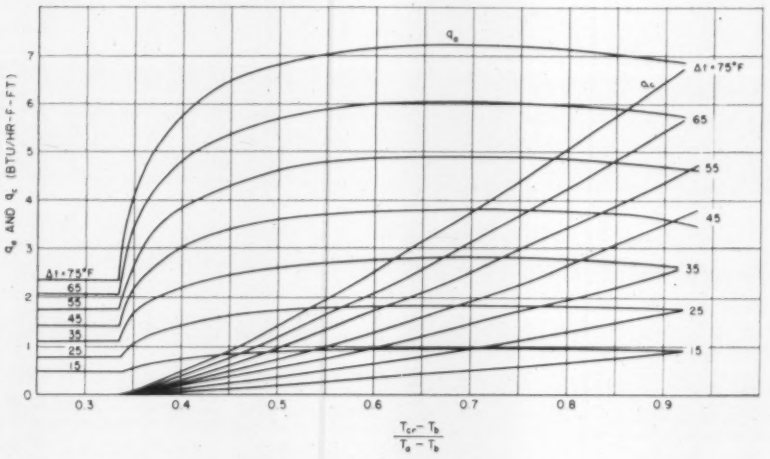

Fig. 6 — Variations of q_a and q_c for a joist space 16-in. wide x 7½-in. high at various temperature differences

Heat Balances

The heat transfer between the air in the joist space and the surrounding surfaces is by convection only. Therefore the heat balance of Equation 30 can be set up for the air.

$$q_c + q_a = q_b \quad \ldots (30)$$

With the assumption of $h_b = h_a$ explained in the section on *convection*, Equation 30 becomes Equation 31.

$$(T_o - T_b)/(T_a - T_o) = 1 + q_c/q_a \quad \ldots (31)$$

Substitution of Equations 8 and 20 into Equation 31 yields Equation 32.

$$\frac{T_o - T_b}{T_a - T_o} = 1 + \frac{H_c A_c (T_c - T_o)}{2(T_o - T_b)\int_0^{y/L} h_a dx'} \quad (32)$$

The average temperature of the joist surface, T_c is obtained from the theoretical temperature variation curve (curve 3 in Fig. 5) for a given

value of T_{cr}. Equation 32 can be solved for T_o as a function of T_{cr} for the given values of T_a and T_b. With the functional relation between T_o and T_{cr} known, Equations 8 and 20 can be solved for q_c and q_a for the given values of T_a, T_b and T_{cr}.

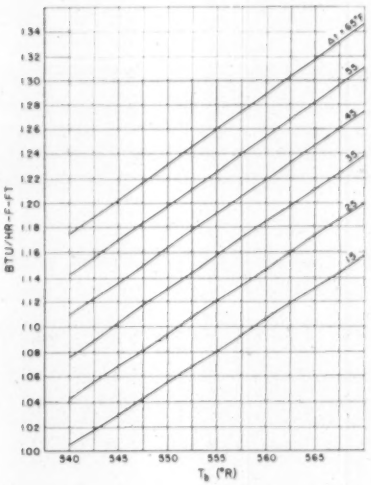

Fig. 7 — Rate of total heat transfer for 1-ft of joist section 16-in. wide x 7½-in. high x 1-ft long, in Btu per (hour) (foot) (Fahrenheit degree) with bare inside surfaces, $e_a = e_b = e_c = 0.90$

For the limited range of the temperatures encountered here, it was possible to express the calculated values of q_c and q_a as the functions of $(T_{cr} - T_b)/(T_a - T_b)$ and $T_a - T_b = \triangle t$. This is true because a convection heat transfer is essentially based on the temperature differences rather than the absolute temperatures. Fig. 6 shows these values of q_c and q_a calculated.

Next, a heat balance is set up on the joist in accordance with Equation 33.

$$q_c = q_{ac} + E_{ac} - q_{cb} - E_{cb} \quad \ldots(33)$$

Substitution of Equations 23, 24, 25, and 26 into Equation 33 yields Equation 34.

$$q_c = 0.173 e_a e_c A_a S_2' S_3' S_4' \left[F_{ac} + (1-e_b) F_{ab} F_{bc}\right] \left[\left(\frac{T_a}{100}\right)^4 - \left(\frac{T_{cr}}{100}\right)^4\right] + \frac{3}{2} K_a A_a \frac{T_a - T_{cr}}{L} - 0.173 e_c e_b A_a S_2'' S_3'' S_4'' \left[F_{bc} + (1-e_a) F_{ba} F_{ac}\right] \left[\left(\frac{T_{cr}}{100}\right)^4 - \left(\frac{T_b}{100}\right)^4\right] - 3 K_a A_a \frac{T_{cr} - T_b}{L} \quad \ldots(34)$$

Final Calculations

For the given values of T_a, T_b, and the surface emissivities, Equation 34 is first solved for an assumed value of T_{cr}. This calculated value of q_c is then compared to the value of q_c obtained from Fig. 6 for the same value of T_{cr}. If these 2 values of q_c do not agree with each other, a new value of T_{cr} is assumed, and the calculation of Equation 34 and the comparison to Fig. 6 are repeated until an adequate agreement is reached. This solution by the method of iteration yields the definite values of q_c and T_{cr} desired. q_a is read off Fig. 6 directly. q_{cb} is calculated from Equation 24.

Finally, the overall heat transfer through a section of joist is obtained from Equation 35.

$$q\,(\text{Total}) = q_{ab} + q_{cb} + E_{cb} + q_b \quad \ldots\ldots(35)$$

Three sets of the overall heat transfer rates per unit temperature difference, $(q\ \text{Total}/T_a - T_b)$ are calculated and are plotted in Figs. 7, 8, and 9. They are for the cases with bare inside surfaces, with aluminum foil on the surface b, and with foil on the surfaces b and c, respectively. The heat transfer rates are calculated and shown on the figures for a section of the 16-in. wide, 7½-in. deep and 1-ft long joist (see Fig. 1).

The emissivities used are 0.9 and 0.03 for the bare surface and the aluminum foil respectively.

Comparison with Experimental Data

Six sets of experimental data are used here for the sake of comparison and support to the present theoretical elaborations. These sets are taken from the extensive experimental data presented in Reference 4. The particular sets are chosen because they were obtained through the experiments with the 3 cases of the joist spaces considered in Figs. 7, 8, and 9.

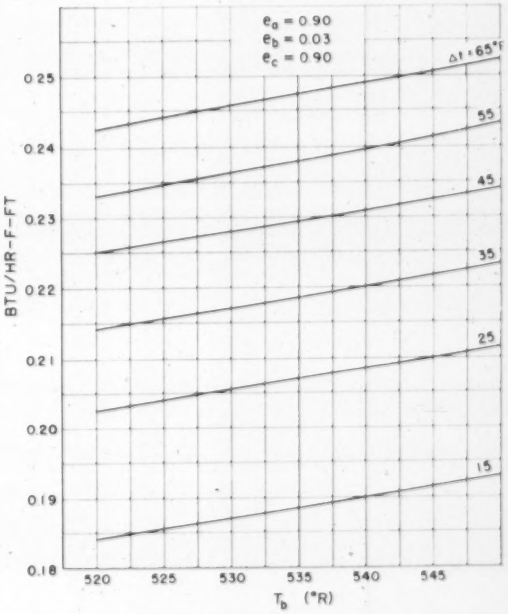

Fig. 8 — Rate of total heat transfer for 1-ft of joist section 16-in. wide x 7½-in. high x 1-ft long, in Btu per (hour) (foot) (Fahrenheit degree) with aluminum foil on bottom surface of joist space

In the experiment, the plate a was made of ¾-in. plywood and the plate *b* was made of ½-in. gypsum board. The conductances of the plates were 1.033 Btu per (hr) (sq ft) (F deg) and 2.80 Btu per (hr) (sq ft) (F deg) respectively. The temperatures T_{ao}, T_a, T_{bo}, T_b, (see Fig. 1) and the temperatures along the joist surface were measured as well as the heat transfer rates during the tests. Reference 4 describes the test in detail.

The total heat transfer rates are calculated from Figs. 7, 8, and 9, for the measured values of T_a and T_b. The overall conductance based on T_{ao} and T_{bo} were then calculated with the known conductances of the plates a and b. These calculated values are compared to the measured values of the conductances in Table 1.

The conductances are also calculated by the conventional method and are presented in the same table. Agreement of the new calculated values with the experimental results are strikingly good. The improvement of the present method over the conventional method is also shown.

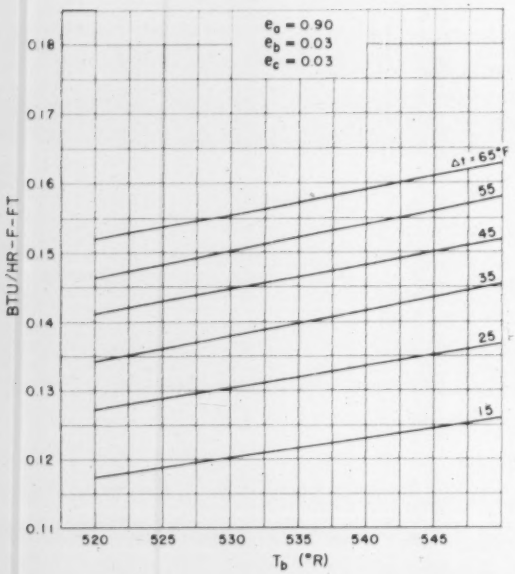

Fig. 9 — Rate of total heat transfer for 1-ft of joist section 16-in. wide x 7½-in. high x 1-ft long, in Btu per (hour) (foot) (Fahrenheit degree) with aluminum foil on both bottom and joist surfaces of joist space

Table 1 — Comparison of the conductances calculated by the present method to those obtained by experiments and to those calculated by the conventional method

Surface conditions	Test conditions, Temperatures, Fahrenheit	Conductance based on T_{ao} and T_{bo} (Btu per hr F deg sq ft)		
		Experimental Results	Calculated Results: By conventional method	Calculated Results: By present method
Bare surfaces	T_{ao} = 122.2; T_a = 109.0 T_b = 97.8; T_{bo} = 87.9	0.3900	0.4227	0.3898
	T_{ao} = 48.4; T_a = 127.8 T_b = 105.8; T_{bo} = 95.8	0.4070	0.4417	0.4080
Aluminum foil on b	T_{ao} = 126.5; T_a = 119.9 T_b = 83.6; T_{bo} = 80.7	0.1570	0.0922	0.1365
	T_{ao} = 154.5; T_a = 145.9 T_b = 89.4 T_{bo} = 84.6	0.1460	0.1060	0.1500
Aluminum foil on b and c	T_{ao} = 127.4; T_a = 122.8 T_b = 82.4; T_{bo} = 79.9	0.0983	0.0994	0.0956
	T_{ao} = 155.9; T_a = 148.4 T_b = 87.4; T_{bo} = 85.2	0.1060	0.1172	0.1038

Conclusions

The analyses shown here present a better insight into the mechanisms of the complicated downward heat transfer through a typical joist space.

A substantial number of simplifying assumptions were made during the course of the theoretical derivations in order to make the analyses more suitable to practical calculations and applications. The final calculated values, however, agree with the experimental results very well, and show a marked improvement over the conventional method. This is largely due to the more accurate reasoning of the mode of heat transfer employed here.

The basic theory studied here may be applied to many other joist section geometries and surfaces. Figs. 7, 8, and 9, may be used directly in the application.

Acknowledgments

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Evaluation of Three Room Air Distribution Systems for Summer Cooling

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This paper is the result of research sponsored by the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, in cooperation with Case Institute of Technology, Cleveland, Ohio

SUMMARY — Three systems of room air distribution for summer were evaluated on the basis of specific criteria for comfort. A theory of room air motion and a philosophy for evaluating comfort conditions are discussed. Extensive tests were made in a room equivalent to a *well-insulated living room* with exposed walls, operated with surface temperatures simulating outdoor conditions up to 100 F. The high sidewall air-supply system would meet the rigid comfort requirements at moderate loads and low supply volumes only. With baseboard radial diffusers, drafts in some parts of the room could not be eliminated. The system using round ceiling diffusers was more satisfactory than either of the others. A comparison is made with earlier tests of all 3 systems for winter heating.

THIS paper describes the performance of 3 residential air-distribution systems during summer cooling and isothermal operations. The object was to evaluate the room air conditions in terms of human comfort and to study in detail the air-flow phenomena. This is a continuation of an investigation reported earlier[1] in which the same 3 systems were used to study air distribution for winter heating, and in which special attention was paid to the winter operations requiring high air volumes at lower supply temperatures, as in heat pump systems. Performance under summer and winter conditions are compared in the present paper.

Comfort Criteria

The term *draft* is here defined as any localized feeling of coolness or warmth of any portion of the body, due to both air movement and air temperature, with humidity and radiation considered constant. The warmth or coolness of a draft was measured above or below the room control condition, and the latter was maintained at 76 F dry-bulb, air movement approximately 30 fpm and located at the center of the room, 30 in. above the floor.

An approximate equation was used to define the difference in effective temperature between any point, x, in the occupied zone of the test room and the control condition, *viz.*:

$$\Delta t = (t_x - 76) - 0.07\,(V_x - 30) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The form of this equation was originally proposed by Rydberg and Norback[2]. Equation 1 differs from that used in the earlier paper of this series by the addition of 30 fpm at the control point. This change was recommended by Straub, in his discussion[3]. Equation 1 takes into account the feeling of coolness produced by air motion. In summer the local air-stream temperature t_x is below the control temperature, hence both temperature and velocity terms are negative; *i.e.*, both of them add to the feeling of coolness. If, in winter, t_x is above the control temperature, any appreciable air velocity will subtract from the feeling of warmth produced by t_x. Thus it is usually possible to have zero difference in effective temperature between location x and the control point in winter, but not in summer.

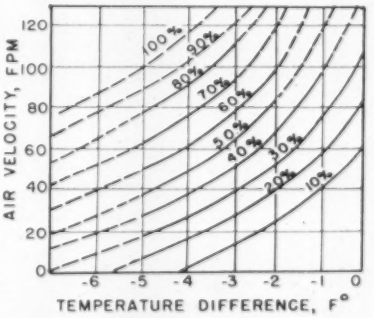

Fig. 1 — Percentage of normal occupants objecting to drafts in air-conditioned rooms (neck region)

Houghten[4] presented data which makes it possible to interpret statistically the percentage of room occupants that will tolerate or object to a given draft condition. Fig. 1 presents Houghten's data, with some extrapolation as required for these studies.

The *occupied zone* was arbitrarily defined as the region in the test room enclosed by imaginary planes 1 ft from each of the 4 walls and 6 ft 2 in. from the floor. Since the air must enter the occupied zone through these imaginary boundaries, the most severe conditions of high air velocity and low temperature were assumed to be found somewhere along these boundaries. Therefore all measurements to locate the *critical draft regions* were made at the boundaries of the occupied zone.

Three comfort criteria were used to evaluate the room air distribution:

1. Draft, *i.e.*, the difference between the local air temperature and velocity and those at the control point.
2. Excessive local air velocities causing movement of hair, eye discomfort, disturbance of paper, fabrics, etc.
3. Vertical air temperature gradients in the occupied zone, causing discomfort due to differences in warmth between head and ankles.

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[1]Exponent numerals refer to References.

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With respect to these 3 criteria, the conditions of Table 1 were selected as the maximum allowable departures within the occupied zone, from the comfort or ideal situation, for summer conditions.

General Conclusions

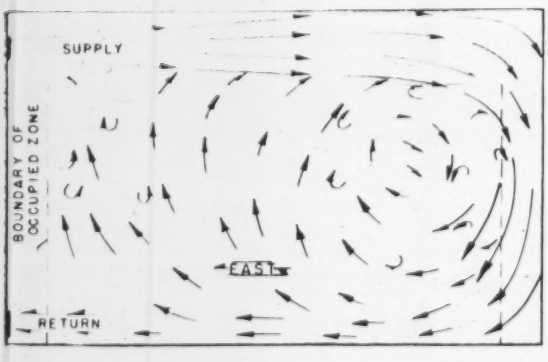
Under the rigid comfort requirements just described, *i.e.*, at least 90 percent of the occupants comfortable in *any* part of the occupied zone, there were marked differences in the results with these 3 systems of air distribution. The air-flow patterns, air supply volume and cooling load were measured and correlated with comfort conditions, for a variety of simulated outdoor temperatures up to 100 F. The high sidewall system would meet the requirements of Table 1 only if the cooling loads and air-supply volumes were low. The system of baseboard radial diffusers, while it produced good mixing of supply and room air with high rates of air supply, exceeded the specified limits of Table 1 from the standpoint of drafts. Excessive air motion was caused in some parts of the room, while there was stagnant air in other parts. The system using ceiling diffusers was capable of satisfactory operation over a wide range of loads. It was therefore more satisfactory than either of the others from the comfort standpoint.

With the high sidewall system, the general pattern of air motion was almost independent of the air-flow rate. When the system with baseboard radial diffusers was operated with an air-flow rate below a critical value corresponding to about 11 air changes per hr, the relatively large gravity forces spilled the cool air into the occupied zone and produced objectionable conditions, and even at higher flow rates the local drafts would be objectionable to about 30 percent of the occupants. With the ceiling diffusers there were objectionable drafts at high flow rates, but since these units make good use of the unoccupied zone near the ceiling for air mixing and entrainment, satisfactory operation was possible at lower flow rates and correspondingly lower air-supply temperatures. With the ceiling diffusers the air-flow pattern was again almost independent of air-flow rate, since gravity forces played a minor role.

In general, all 3 systems responded to the principle that local air velocities in the room are straight-line functions of the air supply volume or number of air changes. Excessive volumes, with smaller temperature difference, were likely to produce too high an air movement throughout the conditioned space; *i.e.*, most of the room became drafty. On the other hand, the absorbing of a given cooling load by supplying small volumes of low temperature air tended to produce *spot* cooling, and discomfort by the gravity drop of slow-moving air jets. There was an intermediate *best rate* of air flow or air change for each system. With low air change, the draft objectionability increased due to low temperature, at high air change it increased due to high velocities. But even the *best* conditions were not always satisfactory. If any best rate of air circulation could be specified for such a variety of conditions it would be around 10 or 12 air changes per hour.

Fig. 2 *(below)* **— Air-flow patterns in test room; high sidewall grilles, isothermal ventilation conditions**

Fig. 3 *(right)* **— Air-flow patterns in test room; horizontal section through two 12- x 6-in. high sidewall grilles**



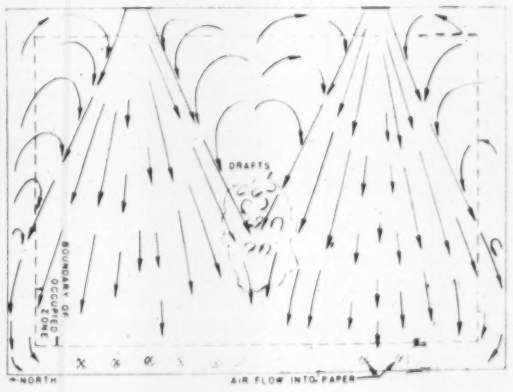


Table 1 — Arbitrary Comfort Limits

1.	Draft, a maximum of 10 percent of the subjects objecting, *i.e.*, 90 percent tolerability, Fig. 1.
2.	Air velocity, a maximum of 50 fpm.
3.	Vertical air temperature difference from floor to ceiling of occupied zone, 5 deg. maximum.

Test Room and Instruments

The test room was 18 × 13 × 8 ft, built to simulate a well-insulated

living room, unfurnished, with 2 walls exposed to summer weather conditions. The exposed walls contained 3 large windows. The attic was insulated but not cooled while the insulated floor had a ventilated crawl space. The room was built in a large laboratory, and since the unexposed walls were subjected to summer temperatures, they were covered with 4 in. of insulation. The heat gain from these insulated walls was around 10 percent of the total heat load. This problem did not exist in the earlier heating tests, but otherwise the room was the same as previously described[1].

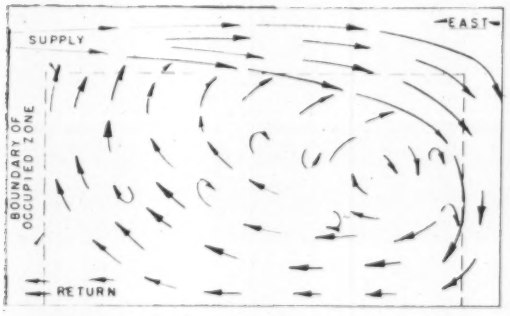
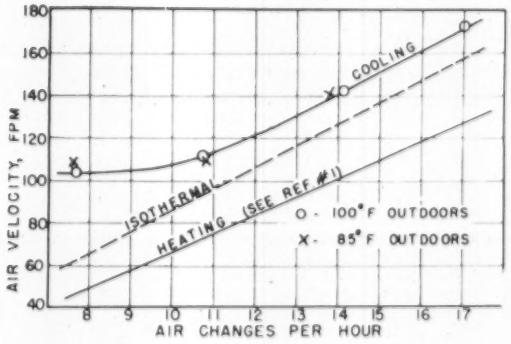


Fig. 4 — Air-flow patterns in test room; high sidewall grilles; shows drop of air stream into occupied zone, cooling operation

Two air-velocity meters were used: (1) a modified commercial instrument of the heated-thermocouple type, and (2) a modified form of the anemometer developed by Nottage at the ASHAE Laboratory[2]. General air movement was indicated with the aid of a smoke gun and by the angular deflections of calibrated air-movement threads, located in square-grid arrangement on 6-in. centers over the boundaries of the occupied zone, as described in the earlier paper[1]. All anemometers were calibrated in a bell-mouth intake of 12-in. size or larger. Floor-to-ceiling temperature gradients were obtained from thermometers and thermocouples on vertical poles. Temperature measurements on wall, window, floor and ceiling surfaces were obtained from fine-wire thermocouples, with the reading stations outside the room. Isothermal operation was included in the tests, to check the conditions that prevail in a residential air-distribution system when cooling or heating is turned off but the blower continues to operate. All tests were run under equilibrium conditions. At a given outdoor temperature the air-flow rate was varied to carry the load at each of several air-supply temperatures. The control condition, in the center of the room at the 30-in. level, was always maintained at 76 F.

Fig. 5 *(below left)* **— Maximum draft velocities with high sidewall grilles. Ceiling of occupied zone (Fig. 4)**



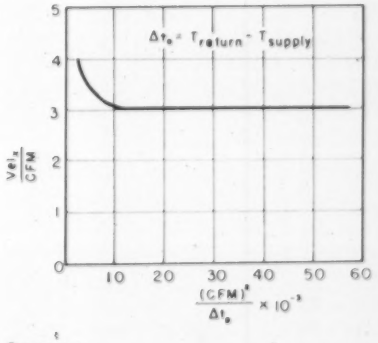


Fig. 6 *(right)* **— Room velocity V, as a function of the ratio of inertia forces to gravity forces**

Test Results

Results of the extensive tests are presented separately for each of the 3 systems, in the following sections. Since previous tests had shown that the location of the returns had little effect on the quantities being measured[1], the only tests reported here were made with a single 18 × 8-in. baseboard return located on one of the inside walls, but the effect of return location was checked. Each set of results is presented first in terms of the general air flow pattern produced by the distribution system, the location of critical draft regions, and the relation of supply temperature and quantity to cooling load when the outdoor temperature remains constant. The system is then discussed from the standpoint of the 3 comfort criteria, *i.e.*, drafts, excessive air

velocities, and objectionable floor-to-ceiling temperature gradients.

System No. 1, High Sidewall Supply Outlets

Flow Pattern, Drafts and Cooling Load: In evaluating flow patterns it should be noted that as long as the inertia forces of forced convection predominate over the gravity forces produced by temperature difference, the circulation velocities in the occupied zone will be directly proportional to the volume flow through the supply openings. The general air flow pattern will depend on the system geometry, (room space and supply outlets), and will be practically independent of the air-flow rate. These conditions were demonstrated in the isothermal tests with these outlets, for which the air patterns are shown in elevation in Fig. 2 and in plan in Fig. 3. As cooling is introduced, the influence of gravity forces on the chilled jet alters the pattern somewhat as shown in the elevation, Fig. 4, that is, the cold air tends to *drop* into the occupied zone. The linear relationship between supply-flow rate and room air velocities is illustrated in Fig. 5, which is a diagram of the maximum air velocities to be found in the occupied zone. At low-flow rates during cooling the gravity forces in the chilled jet tend to increase the velocity of the air entering the occupied zone. During heating the gravity forces are reversed in direction and the velocity of air entering the occupied zone is therefore decreased. As expected, the velocities during isothermal operation are intermediate between those for heating and those for cooling.

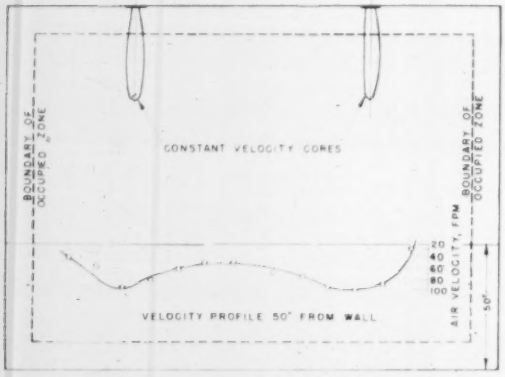


Fig. 7 — Sidewall grilles as used; 60 F deg vane angle. Isovels at grille level and velocity profile at 74 in. from floor; 8 air changes per hr

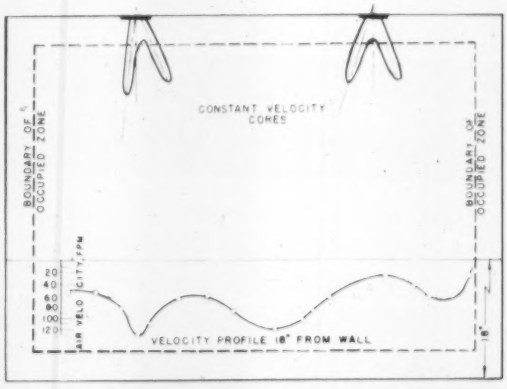


Fig. 8 — Velocity profile and isovels for high sidewall grilles with wide-angle setting of vertical vanes

The effect of gravity forces on the room air motion can be further illustrated by Fig. 6. The ratio $cfm^2/\Delta t_0$ on the abscissas is a factor proportional to the ratio of inertia to gravity forces. The ordinate is the ratio of the velocity V_x at any point in the room to the supply flow rate, and this should remain constant as long as inertia forces predominate. For cooling, the increased gravity effects at low values of the abscissa tend to increase the room draft velocities for a

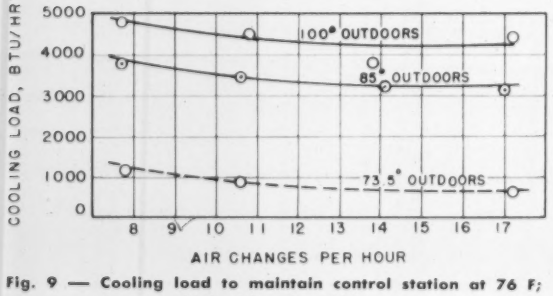


Fig. 9 — Cooling load to maintain control station at 76 F; high sidewall grilles

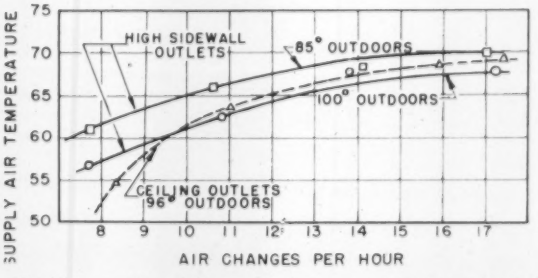


Fig. 10 — Air supply temperatures required to maintain control station at 76 F

given outdoor load, as shown by Fig. 6. The maximum velocities in the occupied zone occurred at the ceiling of the occupied zone, as would be expected.

The foregoing results were all obtained with two 12- × 6-in. grilles, the vertical deflecting vanes in the grilles being set to produce a uniform spread of about 60 deg total angle. A typical velocity profile measured at the top of the occupied zone (6-ft 2-in. level) is shown in plan in Fig. 7. When the vanes were set for a considerably wider spread at the grille, the typical bifurcated patterns were produced[6], and the corresponding velocity profile is shown in Fig. 8.

The cooling load required to maintain the control station at 76 F is shown in Fig. 9, for 3 outdoor temperatures. It is noted that there is a small but definite increase in the heat transfer through exposed surfaces at the lower air supply temperatures, in spite of the lower velocities accompanying the reduced volume required to maintain the control condition. The corresponding air-supply temperatures are shown in Fig. 10. The supply temperatures ranged from 6 to 20 deg below the room temperature.

Fig. 11 *(below)* — Difference in effective temperature between control station and critical draft region; sidewall grilles

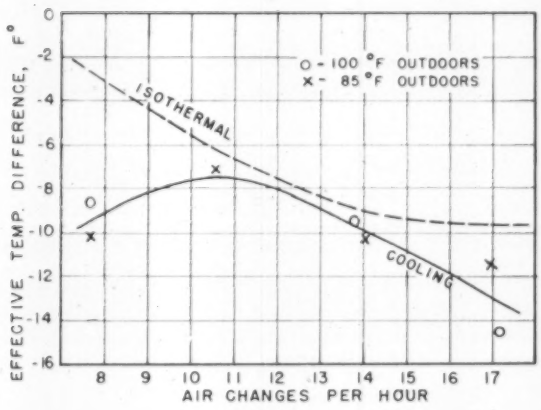


Fig. 12 *(right)* — Objectionability of drafts at various cooling loads; high sidewall grilles; ceiling of occupied zone

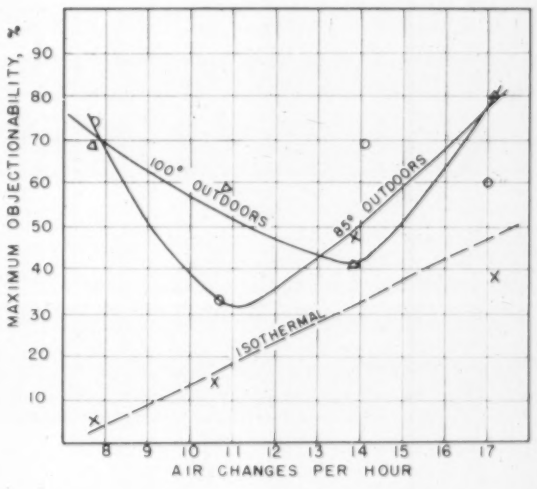
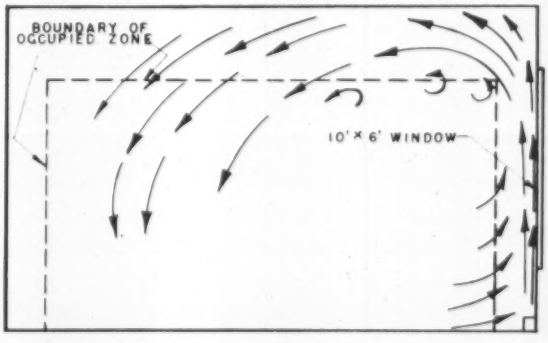
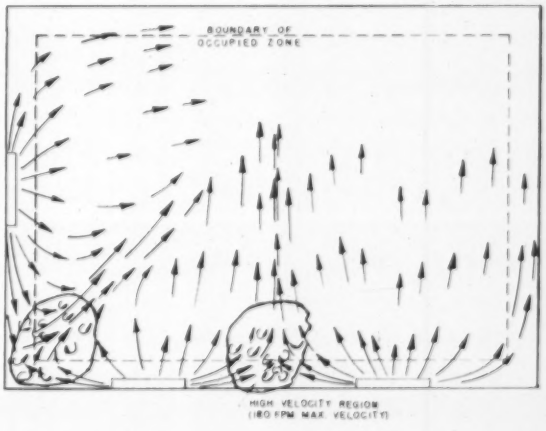


Fig. 13 *(below)* — Air-flow patterns in test room; baseboard diffusers; 96 F outdoors, 17 air changes

Fig. 14 *(right)* — Air-flow patterns in test room, plan view; baseboard diffusers; 96 F outdoors, 17 air changes





Comfort Criteria: Fig. 11 indicates that the minimum difference in effective temperature (Equation 1) is obtained when the air volume corresponds to about 11 air changes per hr. At higher or lower rates of air supply this effective-temperature difference in the critical draft region increases. It would be expected from

Figs. 5, 7 and 11 that a rather large percentage of occupants would object to the drafts at the 6-ft level with high sidewall outlets. Fig. 12 shows the percentage objecting, as evaluated from Fig. 1. With isothermal operation and 8 to 10 air changes per hr, fewer than 10 percent of the occupants will object to these drafts, but when operating with summer cooling the objectionability will exceed 30 percent, even at the most advantageous rate of air supply.

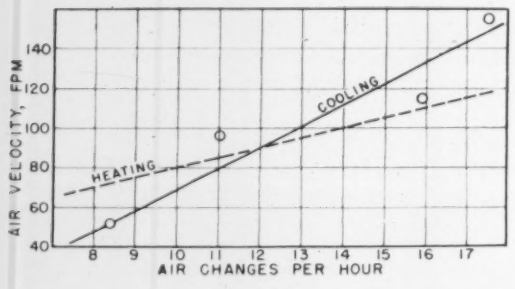


Fig. 15 — Maximum air velocities in critical draft regions with baseboard radial diffusers

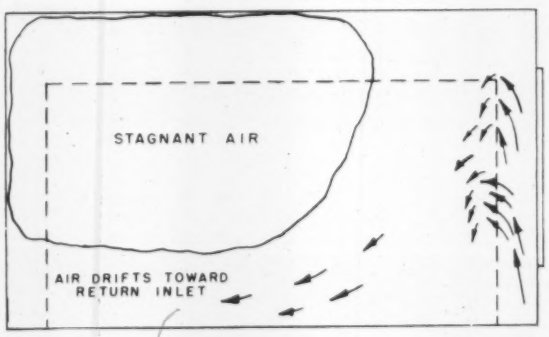


Fig. 16 — Air-flow patterns in test room; baseboard diffusers, 8 air changes; 74 F outdoors; showing *spilling* of cool air into occupied zone

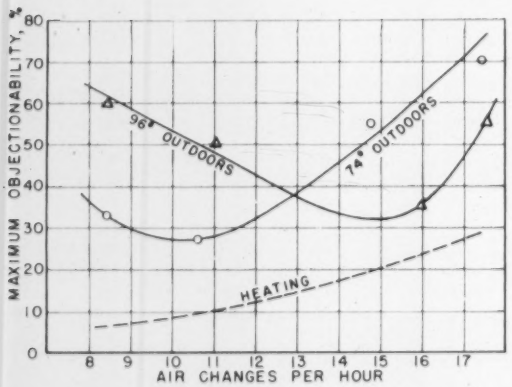
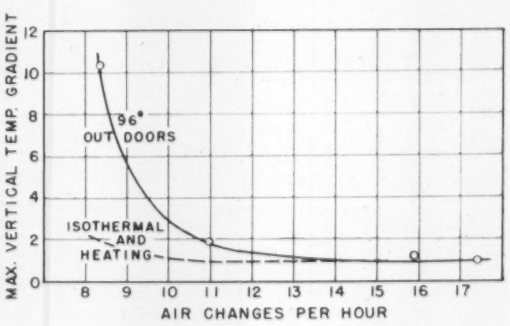


Fig. 17 *(below left)* — Maximum objectionability of drafts at various cooling loads; baseboard diffusers

Fig. 18 *(below)* — Temperature gradients from floor to ceiling of occupied zone; baseboard radial diffusers



Vertical temperature gradients in the occupied zone were small, and did not exceed the 3 deg prescribed in Table 1 except at low air changes. In the previous winter heating tests on the same sidewall system, gradients of 10 deg or even more were observed.

Conclusions for Sidewall Grilles: The general pattern of room air motion remained essentially independent of air-flow rate. The critical draft region occurred at the 6-ft 2-in. level, 9 to 11 ft from the outlets. At any given air-supply flow rate, the air velocities in the critical draft region were highest during cooling, lowest during heating, and intermediate during isothermal operation, (Fig. 5). These differences were attributed to gravity effects.

The floor-to-ceiling temperature differences were below 3 deg in all tests. With appreciable cooling loads, local drafts were objectionable, and velocities exceeded 50 fpm, (Table 1).

System No. 2, Baseboard Radial Diffusers

Flow Pattern, Drafts and Cooling Load: The room air-flow pattern shown in Figs. 13 and 14 prevailed when the air volume was above 11 air changes per hr. The plan view of Fig. 14 indicates 2 critical draft regions at the boundaries of the occupied zone, produced by the merging jets from the baseboard diffusers. The critical draft regions occurred in these same jet-merging regions during heating[1]. Draft velocities again varied directly with air-flow rate, Fig. 15. At high air-flow rates this system *was* able to produce a flow pattern

extending throughout the room, thus uniformly absorbing the cooling load. But below 11 air changes the vertical pattern of Fig. 16 was produced, and the operation was unsatisfactory due to high vertical temperature gradients, stagnant air regions, higher heat-load gains and spot drafts. Below 11 air changes the jets *spilled* into the occupied zone because they had insufficient vertical momentum to overcome the downward-acting gravity forces along the exposed walls*. The cooling load to maintain 76 F at the control station also increased abruptly as the flow rate was reduced below 11 air changes.

Comfort Criteria: At the higher air-flow rates, objectionable local drafts occurred between the diffusers, and at lower flow rates these draft areas were widened. At least one-third of the occupants would find the drafts objectionable at these locations, Fig. 17. The baseboard diffuser system, if operated at high air-change rates, was satisfactory from the standpoint of producing low floor-to-ceiling temperature gradients, Fig. 18. This was true for both cooling and heating[1]. In general, the velocities in the critical draft regions were above the limit of 50 fpm specified in Table 1, (see Fig. 15).

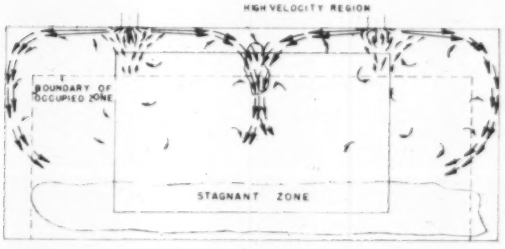


Fig. 19 — Air-flow patterns in test room; ceiling diffusers, 93 F outdoors, 8 air changes

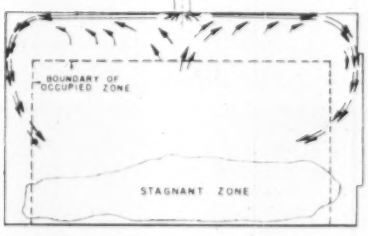
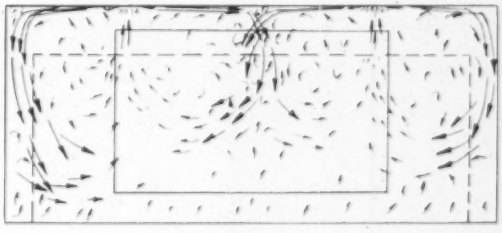


Fig. 20 (*left*) — Air-flow patterns in test room; ceiling diffusers, 93 F outdoors, 8 air changes

Fig. 21 (*right*) — Air-flow patterns in test room; ceiling diffusers, 93 F outdoors, 16 air changes per hr



Conclusions for Baseboard Diffusers: It was entirely possible with the baseboard diffuser system, operated at high air-flow rates, to uniformly absorb the load and to ventilate the entire room. For both cooling and heating, the floor-to-ceiling temperature gradients were low, but high local air velocities occurred near the exposed walls. During cooling the local drafts would be considered objectionable by at least one-third of the normal occupants. With cooling, below 11 air changes, the performance deteriorated.

System No. 3, Round Ceiling Diffusers

Flow Pattern, Drafts and Cooling Load: With 2 commercial ceiling diffusers of the projecting cone type, (6-in. neck), each mounted centrally in one-half of the ceiling, the vertical patterns of Figs. 19 and 20 were produced. In contrast with the operation of the baseboard diffusers, there was no critical flow rate for the ceiling diffusers at which the stagnant zone disappeared. As the flow rate was increased, the air streams traveled farther. The entrainment action also tends to pull the air from the floor level upward, Fig. 21.

Figs. 19 and 20 show that a major quantity of the supply air travels along the ceiling, radially outward from the diffusers, then down the walls, picking up the cooling load near the exposed surfaces. The unoccupied zones near the ceiling and the walls are therefore fully utilized for jet entrainment, giving maximum reduction of jet velocities and temperature differences before the air enters the occupied zone. Air supply temperatures required for 96 F outdoors are shown in Fig. 10.

The critical draft region was between the 2 diffusers, near the center of the room where the air enters the top of the occupied zone, as shown in Fig. 19. The draft velocities were linear with air change, Fig. 22. It was therefore concluded that inertia forces again predominated, as in heating. This is in contrast with Fig. 5, which indicates a leveling out of air velocities in the occupied zone due to the buoyancy at low air-change rates and correspondingly low air-supply temperatures.

Comfort Criteria: Although local velocities are slightly high, Fig. 22,

*Reference 7 covers the general theory of vertical non-isothermal air jets and how to compute maximum travel of upward projected chilled air or downward projected heated air.

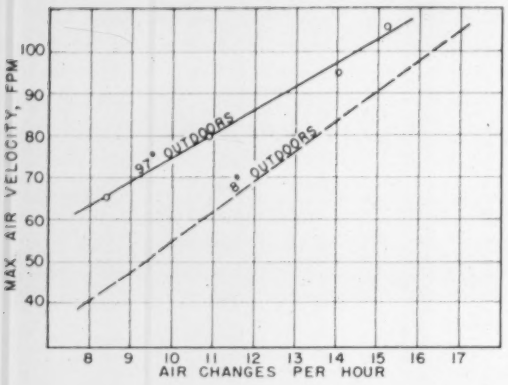
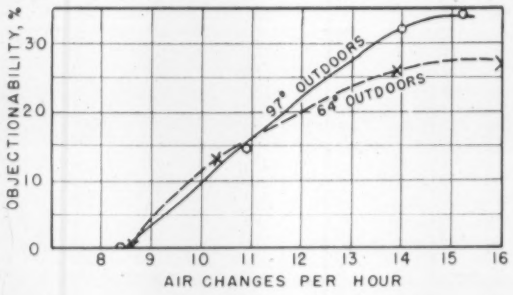


Fig. 22 *(left)* — Maximum draft velocities in occupied zone; ceiling diffusers, cooling and heating

Fig. 23 *(below)* — Objectionability of drafts at various loads; ceiling diffusers



the drafts would not be considered objectionable by more than 10 percent of normal occupants if a low flow rate is used, Fig. 23. At flow rates above 10 air changes, however, the drafts become objectionable to a greater number, and the local air velocities are considerably above the prescribed limit of 50 fpm. The floor-to-ceiling temperature gradients in the occupied zone were negligible for all conditions of cooling operation, but they were as much as 15 deg at low-flow rates during heating[1].

Conclusions for Ceiling Diffusers: The air-flow pattern was independent of flow rate, and was excellent for air distribution in that it made full use of unoccupied zone for air entrainment and load absorption. Limitations of room size made it necessary to keep the flow rate down to 10 air changes per hr or less in order to prevent drafts at the 6-ft level, midway between the 2 diffusers. But the system satisfied all comfort criteria for summer cooling when operated at the lower flow rates.

Acknowledgments

The authors acknowledge with thanks the assistance of James Wahlers and Richard Gido in the extensive experimental work and reporting involved in this project.

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AUTOMATIC PROCESS CONTROL

A book on the subject of automatic control which carries the title *Automatic Process Control* and which is written for engineers has made its appearance. [Published by John Wiley & Sons, Inc., New York, N. Y., priced at $9.00, and obtainable directly from the publisher.] The principles of automatic controls are treated, with emphasis on block diagram and frequency techniques in process control. It begins with process analysis and carries on into generalized behavior of closed-loop systems.

The methods of analysis are used to the fullest extent with enough detail being presented to permit rather close inspection of some of the more difficult problems in automatic process control. There are numerous problems with answers and 9 detailed experiments including the analogue computer.

TEXT ON SUMMER AIR CONDITIONING

A new textbook entitled *Summer Air Conditioning* has recently been made available by Windsor Press, Chicago, Ill. It is a standard size book, 6 in. x 9 in. and contains some 550 pages. The book is priced at $7.50 per copy and is obtainable direct from the publisher at 200 East Ontario St., Chicago 11, Ill. The 3 authors of the book are Seichi Konzo, J. Raymond Carroll and Harlan D. Bareither, all of whom are connected with the mechanical engineering department, University of Illinois, and all of whom are members of the Society.

The information contained in the book is presented in interesting and modern style. Also, the material was written as a text and reference for those seriously interested in learning the fundamentals involved in the cooling and heating of residences. It was prepared especially for the purposes of the *Armed Forces Institute*.

The main idea behind the book is to explain how and why things are done the way they are, and what makes equipment operate the way it does. While it is not specifically intended to be a text prepared for professional engineers, it contains excellent explanations of the general subject. Many engineers will therefore probably find it interesting reading.

Professor Yaglou To Receive 17th Anderson Award

It has been announced that Constantin P. Yaglou, professor of industrial hygiene, Harvard University, School of Public Health, is to receive the seventeenth award of the F. Paul Anderson Medal. The award is to be made at the Annual Banquet on Wednesday, January 28, 1959 at the conclusion of the 65th Annual Meeting of the Society in Philadelphia. By the conditions of its establishment, the medal is given in recognition of outstanding work in the field of heating, ventilating and air conditioning.

Professor Yaglou has been engaged in teaching and research at the Harvard School of Public Health for more than 30 years, and is probably best known for his long-continued studies in the hygienic aspects of air conditioning. During that period, he has contributed many papers and treatises on various phases of the subject in engineering, medical, and public health journals, monographs, or books. Among these have been papers prepared for meetings of the Society and which have appeared in the JOURNAL and TRANSACTIONS over the past three decades.

Professor Yaglou was born in Constantinople, Turkey, where he attended the Greek National Gymnasium and the Greek-French School of Arts and Sciences. He entered the Engineering School of Robert College in 1915, and graduated in 1919 with the degree of B.S.M.E. He completed his formal educational work by obtaining an M.M.E. degree from Cornell University.

Shortly after leaving Cornell University in 1921, he joined the staff of the Society Research Laboratory which was then located in the U. S. Bureau of Mines building, Pittsburgh, Pa. The Laboratory had started operating only the year before under Dean John R. Allen, the first Director. Professor Yaglou joined the staff as research engineer, a position which he held until 1925. It was during these years that the Laboratory undertook its initial work on thermal comfort. During his years at the Laboratory, Professor Yaglou was closely associated with most of these pioneering studies in the development of the original effective temperature scales, in the determination of the original comfort zone, in studies of the physiological effect of heat or cold, and in studies of metabolism and its effect on ventilation problems. During this period, the

Laboratory and the U. S. Bureau of Mines were interested in the fatigue and efficiency of men working in elevated temperatures, as in deep hot mines.

On leaving the Research Laboratory in 1925, Professor Yaglou became associated with the Harvard University School of Public Health, first as an instructor and being advanced through the various faculty grades becoming professor of industrial hygiene in 1947. During his years at the School of Public Health, Professor Yaglou has conducted further studies in the comfort, health, and therapeutic aspects of air conditioning; on working efficiencies in climatic extremes, and in many other phases of the University program in connection with industrial hygiene.

While still at the Society Laboratory in 1923, Professor Yaglou became a member of the Society and has always taken an active part in its programs and has contributed generously of his time to the furtherance of many Society projects. He was a member of the Guide Publication Committee in 1926, 1946 and 1947. He served on the Nominating Committee as a delegate from the Massachusetts Chapter in 1932 and 1938. A member of numerous Research Technical Advisory Committees, Professor Yaglou served on Comfort Air Conditioning from 1929 to 1937, and as its chairman from 1931 to 1936. He was chairman of Re-Study of Comfort Chart and Comfort Line in 1932, a member of Comfort Standards for Summer Cooling in 1935-36. He served on Sensations of Comfort in 1938 and from 1944 to 1947, serving as its chairman in 1946-47. He was a member of the Committee on Instruments from 1939 to 1943, Navy Studies in 1948, Human Calorimetry from 1949 to 1956, and Physiological Research since 1955.

Also active in Chapter activities, Professor Yaglou served on the Board of Directors of the Massachusetts Chapter in 1936 and 1941; he was vice president of the Chapter in 1937 and 1939, and president in 1940.

Professor Yaglou holds membership in *APHA, AIHA, NRC, AAAS*, Sigma Xi, and Delta Omega. He also holds a commission as Commander in the U.S.N.R.

The medal was named for Dean F. Paul Anderson of the University of Kentucky, Society president in 1927. The F. Paul Anderson Medal was established in 1930 through a gift to the Society by Thornton Lewis of Philadelphia, Pa., who served the Society as president for 1929.

Members of the 1958 F. Paul Anderson (Honors and Awards) Committee are: A. J. Hess, Los Angeles, Calif., chairman; John W. James, Chicago, Ill.; C. H. Pesterfield, East Lansing, Mich.; N. H. Peterson, San Francisco, Calif.; R. A. Sherman, Columbus, Ohio; and E. F. Snyder, Jr., Minneapolis, Minn. (Ex Officio).

News, Notes and Comments concerning
SOCIETY RESEARCH

B. H. Jennings Director of Research, 7218 Euclid Ave., Cleveland 3, Ohio
C. M. Humphreys, Asst. Director J. E. Loucks, Asst. Dir.-Industry Relations

Projects in operation at the Laboratory always make news as they progress through their various steps. So also the meetings of the TAC's bring out points interesting to many besides the committee members. Here is a summary of what has been happening.

Tac Meetings

Sound and Vibration Control: A special meeting was held at Syracuse, N. Y., on September 26th when the committee was given the opportunity of touring the research facilities of Carrier Corporation. The committee voted to recommend to the Guide Committee that improved data on the attenuation of sound in lined ducts be considered for inclusion in THE GUIDE and that they work with the Publication Committee in arranging for papers on the subject. It was also recommended that revised data on the typical performance of sound traps be considered.

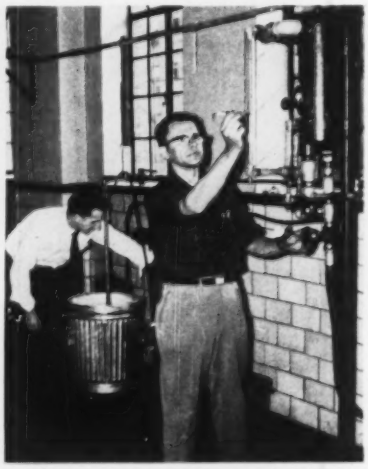
The committee devoted a considerable amount of attention to the report of Mr. Kerka concerning the progress of work on sound at the Research Laboratory and to reports of its several subcommittees, including those on Sound Attenuation in Ducts and on Sound Power Level of a Fan.

A report of the progress being made by the *ASRE*-ASHAE Joint Committee on Equipment Sound Testing stated that the proposed standard for the reverberant-room method has been written and is in process of review by the members of the Joint Committee. It was also reported that various trade groups are depending on the work of that committee for guidance and that there is a great need for a standard method of measuring in-duct noise.

Plans of the committee looking toward a program feature for a future annual meeting were also reviewed, as was the committee's standing agenda on research programs.

Air Distribution: At its meeting held at the time of the Semi-Annual Meeting in Minneapolis, the Technical Advisory Committee on Air Distribution took action to recommend to the Committee on Research that the Laboratory undertake a review and analysis of existing data on friction losses and noise attenuation in turning vanes and take-off fittings.

It also recommended to the Committee on Research that a cooperative



Apparatus for studying capacity of piping for steam and condensate flow is complete and project is in its early stages.

project be activated at the University of Buffalo for the study of pressure losses in duct enlargements. The Committee also heard a report concerning work being done under its auspices at Case Institute of Technology. Its Subcommittee on High-Velocity Systems reported that material on this subject had been prepared for THE GUIDE. Prof. R. G. Nevins, Kansas State College, reported that ducts have been fabricated for the project there covering heat gain and loss from ducts. He reported that the heat loss studies would be made during the winter of 1958-59 and that heat gain studies would be made through the summer of 1959.

Laboratory Research Projects

Comfort Studies: Beginning in late September studies have been in progress using 6 subjects in the Environment Laboratory, carried out with the idea of exposing them to conditions within and slightly outside the comfort range to find optimum conditions by interpolation from the data. These studies are a part of the first phase of the comfort research program projected for the recently completed Environment Laboratory. In August and September, prior to starting studies in the true comfort range, exploratory studies were carried out in the warm region outside the comfort range with a panel of 3 subjects.

Shading Project: A paper by Mr. Ozisik and Mr. Schutrum presenting the results of using roller shades inside glass in window openings has been completed. The paper is the result of the studies made in recent months. The project has now turned to studying the use of draperies in window openings. Preliminary tests are also being made with between-glass shading.

Other Laboratory Projects: The program on noise in ducts is continuing and noise generating studies on turning-vanes have been completed. In preparation for the noise attenuation phases of the project plans have been drawn for an improved acoustical horn having a large (6-×6-ft) mouth.

Already tests have been made in connection with the study of steam and condensate flow in pipes, and the whole project continues to be actively pursued in the Laboratory.

View of the Port of Philadelphia

Hearty Philadelphia Welcome Awaits Opening of 65th Annual Meeting

The 65th Annual Meeting and 14th International Heating and Air Conditioning Exposition will open in Philadelphia in a few short weeks; from January 26 through 29 with the Annual Meeting at the Bellevue-Stratford Hotel and the Exposition in Convention Hall. Advance reservations indicate a very large attendance may be expected and the Philadelphia Chapter is looking forward to extending the hospitality of the City of Brotherly Love.

The ASHAE Registration Desk will open in the Bellevue-Stratford at 10 o'clock on Sunday morning, January 25 and in the afternoon beginning at 4 o'clock there will be a Welcome Pennsylvania Dutch Koffee Klatch.

Exposition

The 14th International Heating and Air Conditioning Exposition, under the auspices of ASHAE, will open at noon on Monday, January 26 in Convention Hall and will remain open Monday through Thursday from 12 noon until 10 p.m. each day.

Dr. Eric A. Walker
President
The Pennsylvania State University

The Society exhibit located in Booth No. 1018, will demonstrate solar heat gain through shaded and unshaded windows based on work accomplished at the ASHAE Research Laboratory. This will be a *live* presentation featuring a ¼" scale model house, lights simulating the sun at different hours of the day and instrumentation to measure the light hitting shaded and unshaded windows. In addition, other Society activities will be prominently displayed.

Sessions

Pres. E. R. Queer, University Park, Pa., announced that the Program and Papers Committee, John Everetts, Jr., chairman, Philadelphia, has arranged for 7 technical sessions including 1 topical session and 3 symposiums. It is planned to hold one session on Monday, 2 on Tuesday morning, 2 on Wednesday morning and 2 on Wednesday afternoon.

PROGRAM — 65TH ANNUAL MEETING

Bellevue-Stratford Hotel **January 26-29, 1959** **Philadelphia, Pa.**

(All meetings and events at Bellevue-Stratford unless indicated otherwise)

Sunday — January 25

10:00 a.m. REGISTRATION
10:00 a.m. Council Meeting
3:00 p.m. Welcome-Pennsylvania Dutch Koffee Klatch (*Clover & Red Room*)
8:00 p.m. Movies (*Crystal Room*)

Monday — January 26

9:00 a.m. REGISTRATION
9:00 a.m. FIRST SESSION
Call to Order — Pres. E. R. Queer
TOPICAL SESSION ON COMFORT
Charles S. Leopold, *Moderator*
Researches on Heating and Ventilation in Relation to Human Comfort, by Thomas Bedford
Metabolic Patterns in Stressful Environments, by Nello Pace, M.D.
Environment Reactions in the 80 to 105 F Zone, by B. H. Jennings and Baruch Givoni

9:30 a.m. Ladies' Bus Tour of Old Philadelphia
Buses leave from — Sheraton, Warwick, Bellevue-Stratford and Benjamin Franklin

12:00 noon EXPOSITION (Closes at 10:00 p.m.)

12:15 p.m. WELCOME LUNCHEON (*Ballroom*)
Toastmaster: E. K. Wagner, *General Chairman*
Invocation: P. H. Yeomans
Speaker: Hon. Richardson Dilworth, *Mayor of Philadelphia*

2:00 p.m. Ladies' Bus Tour of Old Philadelphia
Buses leave from — Sheraton, Warwick, Bellevue-Stratford and Benjamin Franklin

7:30 p.m. Get-Together Party (*Grand Ballroom-Sheraton Hotel*)
Social Hour — Buffet Dinner — Entertainment
Dancing — Howard Lanin — Orchestra

Tuesday — January 27

9:00 a.m. REGISTRATION
9:30 a.m. SECOND SESSION
Call to Order — 1st Vice Pres. A. J. Hess
Supply Outlet Locations for Basement Heating, by J. R. Wright and D. R. Bahnfleth
Pulsations in Single-Port Gas-Fired Residential Heating Equipment, by C. F. Speich and A. A. Putnam
Low Frequency Combustion Noise in Oil-Burning Equipment, by G. J. Sanders and W. E. Lawrie
Omni-Directional Low-Speed Hot-Wire Anemometer, by J. F. Kemp (by title only)

9:30 a.m. THIRD SESSION
Call to Order — 2nd Vice Pres. Walter A. Grant
SYMPOSIUM ON HYDRONICS
P. N. Vinther, *Moderator*
Design of Water Piping Systems, by B. L. Sturdevant
Noise and Vibration in Water Piping Systems, by W. L. Rogers
Selection of Pumping Equipment, by G. F. Carlson
Refrigerant Piping, by J. R. Chamberlain

10:00 a.m. Ladies' Bus Tour of Historical Mansions
Luncheon (*Madison Room, Presidential Apartments*)
Buses leave from — Sheraton, Warwick, Bellevue-Stratford and Benjamin Franklin

12:00 noon EXPOSITION (Closes at 10:00 p.m.)

12:15 p.m. Life Members' Luncheon

Wednesday — January 28

9:00 a.m. REGISTRATION
9:30 a.m. FOURTH SESSION
Call to Order — Treas. J. H. Fox
Frost Formation and Heat Transfer on a Cylinder Surface in Humid Air Cross Flow, Parts I and II, by P. M. Chung and A. B. Algren
Downward Heat Transfer Through a Joist Space, by P. M. Chung and C. E. Lund (by title only)
Annual Energy Use for Electric Space Heating, by R. L. Boyd
Heating by Hypocaust, by E. Daisley Thatcher

9:30 a.m. FIFTH SESSION
Call to Order — Pres. E. R. Queer
SYMPOSIUM ON HEAT PUMP PERFORMANCE
G. B. Priester, *Moderator*
Performance of Water Source Heat Pump for Office Building in Southwest, by F. L. McFadden, Jr.
Performance of Water Source Heat Pump for Office Building in Northwest, by J. Donald Kroeker
Performance of Package Air Source Heat Pump Units, by W. A. Spofford
Operation of Large Air Source Central Heat Pump Systems, by E. R. Ambrose

12:00 noon Exposition (Closes at 10:00 p.m.)

12:30 p.m. Ladies' Luncheon and Fashion Show by John Wanamaker (*Ballroom — Warwick Hotel*)

2:00 p.m. SIXTH SESSION
Call to Order — 1st Vice Pres. A. J. Hess
Probe for Thermal Conductivity Measurement of Dry and Moist Materials, by W. Woodside
Heat Gain through Windows Shaded by Metal Awnings, by Necati Ozisik and L. F. Schutrum
A New Method for Calculating Radiant Exchanges by Benjamin Gebhart

2:00 p.m. SEVENTH SESSION
Call to Order — Pres. E. R. Queer
SYMPOSIUM ON CORROSION AND WATER TREATMENT
W. G. Hole, *Moderator*
Water Treatment to Inhibit Corrosion, by F. Hogdon
Corrosion from Insulation, by C. E. Ernst
Hot Water and Anti-Freeze Systems, by L. D. Polderman
Specification Problems in Water Treatment, by W. L. Andrews
Taking the Mystery out of Water Treatment, by Mrs. Olivia Burkey

6:00 p.m. Social Hour (*Clover Room*)

7:15 p.m. 65th ANNUAL BANQUET (*Ballroom*)
Toastmaster: Albert J. Nesbitt
Invocation: Rev. Lewis T. Briner, Calvary Presbyterian Church, Wyncote, Pa.
Speaker: Eric A. Walker, president, The Pennsylvania State University
Introduction and Installation of 1959 Officers
Presentations
Dancing (*Rose Garden, 18th Floor*) from 10:00 p.m.
Howard Lanin — Orchesta

Thursday — January 29

10:00 a.m. Council Meeting
10:00 a.m. Auf Wiedersehen Coffee Hour (*Clover Room*)
12:00 noon EXPOSITION (Closes at 10:00 p.m.)

A. J. Nesbitt
Toastmaster
Annual Banquet

Banquet

The Annual Banquet on Wednesday evening January 28, 1959, highlight of the 65th Annual Meeting, will be honored by the presence of Dr. Eric A. Walker, president of The Pennsylvania State University, who will deliver the banquet address.

The subject of Dr. Walker's address will be *The Morning After for Education*. In developing his topic he will review briefly the events which brought about the *great debate* over education during the last two years—the shortage of engineers, the *tidal wave* of students caused by the increased birth rate during and after World War II, and the launching of Sputnik I. The *debate* has been more of an argument than a discussion and Dr. Walker feels it is time to gather some hard facts about American education, find out what can be done to improve our educational offerings, and then set about doing these things calmly and energetically. In the course of his address he will expect to offer concrete suggestions; especially as they apply to the education of scientists and engineers.

Dr. Walker was born in England in 1910. He was graduated from the Wrightsville, Pa. High School and holds 3 degrees from Harvard University; B.S. in electrical engineering, M.S. in business administration and Sc.D. in engineering. In addition he has been awarded honorary degrees by Temple and Lehigh Universities and Elizabethtown College.

He taught electrical engineering at Tufts College and the University of Connecticut, and in 1942 was associate director of the Underwater Sound Laboratory at Harvard University.

After World War II he became director of the Ordnance Research Laboratory and head of the Electrical Engineering Department, The Pennsylvania State University. In 1951 he was appointed dean of the College of Engineering, was named vice president for research in 1956 but was selected as president to succeed Dr. Milton Eisenhower before he had time to become vice president.

He has repeatedly served the United States Government as an administrator, scientist and engineer and currently is vice chairman of the President's Committee for Scientists and Engineers and is a member of the *National Research Council's* Committee on Undersea Warfare, the Army's Scientific Advisory Committee, and the Naval Research Advisory Committee. Dr. Walker is a Fellow of *AIEE*, *The American Physical Society*, and the *American Acoustical Society* and a member of *IRE*, the *American Institute of Physics*, *ASEE*, Sigma Xi, and Tau Beta Pi.

Dr. Walker will be introduced by A. J. Nesbitt, former Philadelphia Chapter officer of ASHAE and prominent native Philadelphian who this year received the third Annual Citizen Volunteer Award for outstanding service to the community by his participation in numerous Philadelphia health and welfare services. He is a registered engineer in the states of Pennsylvania, New Jersey and New York and a member of the *National Society of Professional Engineers*. He is an authority on heating and ventilating, particularly of public school buildings, and has contributed numerous technical articles on this subject.

J. J. Hucker, banquet chairman of the Philadelphia Chapter Committee on Arrangements, advises that the Annual Banquet will begin at 7:15 p.m. in the ballroom of the Bellevue-Stratford. It will be preceded by a social hour in the Clover and Red room at 6 p.m. Following the Annual Banquet there will be dancing in the Rose Garden on the 18th floor beginning at approximately 10 o'clock.

Hon. Richardson Dilworth
Mayor,
City Of Philadelphia

Welcome Luncheon

The Honorable Richardson Dilworth, Mayor of Philadelphia, will address the Welcome Luncheon at 12:15 on Monday. E. K. Wagner, general chairman of the Committee on Arrangements, will be the toastmaster, and the invocation will be delivered by P. H. Yeomans, past president of the Philadelphia Chapter. Mayor Dilworth, is a descendant of a long line of prominent Pennsylvanians. His paternal great, great-grandfather settled in Lancaster County in 1750 and his maternal great, great, great-grandfather settled in Philadelphia in 1690. He is a Marine Corps veteran of both World Wars I and II. Awarded the purple heart in World War I and discharged after World War II with the rank of Major, he currently holds the reserve rank of lieutenant colonel in the U. S. Marine Corps. He was graduated from Yale Law School, *cum laude* in 1926, has practiced law in Philadelphia from that time until he was elected Mayor. As Mayor he has concentrated his efforts on health, welfare and recreation programs as well as urban renewal and traffic and transportation.

Special Events and Tours

In addition to the outstanding technical sessions and the aforementioned Annual Banquet and Welcome Luncheon it is also planned to have a Monday Night Get-Together Party, sightseeing tours for the ladies, and a ladies' luncheon and fashion show.

The Get-Together Party on Monday evening will be held in the grand ballroom of the Sheraton Hotel beginning

at 7:30 and consisting of a social hour, buffet dinner and dancing.

There will be 2 sightseeing tours of Old Philadelphia on Monday; one at 9:30 a.m. and the other at 2 p.m. On Tuesday morning a tour of historical mansions is scheduled for the ladies with a Luncheon in the Madison Room of the Presidential Apartments. Wednesday at 12:30 p.m. in the ballroom of the Warwick Hotel there will be a ladies' Luncheon and a Fashion Show presented by John Wanamaker.

If reservations have not already been sent in for Special Events, please do so immediately. Due to the large attendance anticipated for both the Annual Meeting and Exposition it is also imperative that hotel reservations be made promptly to insure securing the accommodations desired.

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FOUR MEMBERS ELECTED AS FELLOWS

The By-Laws permit the Council to confer the membership grade of Fellow on members who have attained unusual distinction. At its meeting on October 18, the Council selected four members to become Fellows. Their biographies are presented here.

Merrill F. Blankin, Society president in 1943, is president of the Blankin Equipment Corp., Philadelphia.

A product of local schools, Mr. Blankin attended Drexel Institute of Technology.

M. F. Blankin
Philadelphia, Pa.

After completing his education, he worked for a year as transitman and draftsman with the City of Philadelphia Surveying Corps. In 1917, he joined the Haynes Selling Co., Inc., as draftsman, and successively became sales engineer, secretary, vice president, and was elected president in 1931. The firm later became the Haynes Blankin Co., and then the Blankin Equipment Corp.

Besides serving as Society treasurer, vice president and president, Mr. Blankin served on numerous Council and General Committees including Finance, Admission and Advancement, Rewrite Membership Application Blank, Review, Exposition Advisory, Membership, and chairman, F. Paul Anderson Award. He was toastmaster at the Semi-Annual Meetings in Buck Hill Falls, 1934 and 1936; general chairman of the Committee on Arrangements, 48th Annual Meeting, January 1942; honorary chairman and toastmaster, 61st Annual Meeting, January 1955. Mr. Blankin holds the distinction of having attended every Annual Meeting of the Society since 1925. He served as chairman of the Membership Committee in 1944; chairman of the first Public Relations Committee, 1948; member of the first Honors and Awards Committee; and is a member of the current Building Committee.

Mr. Blankin served the Philadelphia Chapter as treasurer, vice president, and president; he was a member of its board of governors and chairman of numerous chapter committees.

He is a registered professional engineer in the state of Pennsylvania; holds membership in the Engineers' Club, Union League and Kiwanis Club of Philadelphia; member of the board of managers of Roxborough Memorial Hospital and Roxborough *YMCA;* president of Manufacturers' Golf and Country Club; vice president of Philadelphia Chapter *PSPE;* former president of Producer's Council Club of Philadelphia and Executives Association, Philadelphia; general chairman of the 1955 Professional Engineers National Convention held in Philadelphia.

Burgess H. Jennings, director of research for ASHAE since 1957, conducts operations of the Society research program both at the ASHAE Research Laboratory, Cleveland, Ohio, and at cooperating institutions.

B. H. Jennings
Cleveland, Ohio

Born in Baltimore, Md., Professor Jennings attended Johns Hopkins University where he was granted his B. E. in 1925, and Lehigh University, receiving his M. S. in mechanical engineering and M. A. in mathematics. He entered the teaching profession in 1926 on the staff of Lehigh University. While at Lehigh, he attained the rank of associate professor and served as director of the Mechanical Engineering Laboratories. In 1940, he was appointed professor of mechanical engineering at Northwestern University, Evanston, Ill., and served as chairman of that department from 1942 to 1957.

From early in his professional career, Professor Jennings has been an active consultant, handling many major clients.

The third facet of his career — that of research — has actively engaged his attention for years. Professor Jennings has pursued interests in the fields of thermodynamics, psychrometry, human engineering, fluid flow, gas turbines and compressors, ventilating and air conditioning, and atomic energy. As a result of his research interests and activities, he is the author of some 40 research papers and articles; eight engineering textbooks; prepared the refrigeration section for the *Kent* Handbook; edited the *ASRE Data Book* in 1949 and 1951; founded and edited the magazine *Lubrication Engineering*, 1944 to 1950.

With ASHAE, Professor Jennings served on the Guide Publication Committee as 1953 chairman, as a member of various Technical Advisory Committees, Research Executive, Research Long-Range Planning, and as chairman, Committee on Research. He is past president and fellow, *ASRE;* fellow-member, *ASME;* member of Tau Beta Pi, Pi Tau Sigma, Sigma Xi; awarded the Richards Memorial Award of Pi Tau Sigma in 1950 as *the most outstanding Mechanical Engineer within 25 years after graduation;* listed in *Who's Who in America, Who's Who in Engineering, Who's Who in the Midwest* and *American Men of Science.*

Richard C. Jordan, head of the department of mechanical engineering at the University of Minnesota, former vice president and president of the Minnesota Chapter, is a nominee for a second term on the Committee on Research.

Professor Jordan has spent his educational and professional career largely in connection with the University of Minnesota. He was awarded a Ph. D. from the University in 1940, having previously received a B. S. in aero engineering and an M. S. in mechanical engineering. Before becoming associated with the University Engineering Experiment Station in 1937, he spent a few years in charge of the Air Conditioning Division of Central Supply Co., Minneapolis branch of American Radiator and Standard Sanitary Corp., and a year as instructor in petroleum engineering at the University of Tulsa in Oklahoma.

A member of many of the Society's Technical Advisory Committees, Professor Jordan is also a fellow of *ASRE;* former

president, *ASRE;* recipient of that Society's Outstanding Publications Award in 1953; contributor to numerous technical publications; member of several other engineering societies and fraternities; former consultant on the Advisory Panel for Engineering Sciences, National Science Foundation; member of *National Research Council;* served as *Council* delegate at the 9th

R. C. Jordan
Minneapolis, Minn.

International Refrigeration Congress held in Paris in 1955; honorary vice president of *Engineers Council for Professional Development* at the same Congress; delegate to the Executive Committee meetings of *IIR* in Paris, 1954, and the Commission meetings in Moscow and Prague, 1958; is currently chairman of the U. S. National Committee and U. S. delegate to the *International Institute of Refrigeration.*

Benjamin H. Spurlock, Jr., professor of mechanical engineering at the University of Colorado, Boulder, Colo. was director of the University's graduate studies, department of mechanical engineering, from 1946 to 1951.

Professor Spurlock was born in Lithonia, Ga. Prior to graduating from the Georgia Institute of Technology in 1938 with a B.S. degree in engineering, he was employed as an accountant for Southern Railway, Atlanta, Ga., as a sales engineer for the Union Oil Co. of California and as a design engineer for Eagan Cotton Mills, Atlanta. In 1939 he received an M.S. degree from Massachusetts Institute of Technology, continuing his studies at the University of California the following year. In 1940 he accepted a position as instructor of engineering at the University of Colorado. Two years later, he was appointed an assistant professor. He lectured at Yale University, New Haven, Conn., returning to the University of Colorado in 1946. He was made an associate professor of mechanical engineering in 1947.

As a consulting engineer, Professor Spurlock became associated with Pratt and Whitney Aircraft and Air Material Command. Besides his duties at the University of Colorado, he served as consultant to the city of Denver. He was chairman of the steam heating division of the Denver Board of Examiners, a position he held since its beginning in 1952.

Professor Spurlock was the recipient of a Fulbright grant in 1955, and was invited to lecture and serve as a consultant to the College of Engineering in Baghdad, Iraq. More recently, he spent the past summer in attendance at the Atomic Energy Commission's Nuclear Engineering Institute, Berkeley, Calif.

Active in both Society and chapter affairs, he has served on several Technical Advisory Committees; the Committee to Codify Council Policies, the Finance and Chapter Relations Committees; he was president of the Rocky Mountain Chapter in 1951; and honorary chairman of the 1953

B. H. Spurlock, Jr.
Boulder, Colo.

Semi-Annual Meeting held in Denver; a past member of *ASRE* board of directors, he has been a member of the editorial board of *ASEE's Heat Power News;* is author or co-author of technical papers in the JOURNAL and TRANSACTIONS.

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OLDEST PAST PRESIDENT IS ENERGETIC AT 92

Past Pres. C. V. (Charlie) Haynes, now living near Framingham, Mass., leads as full a life as ever. He walks several miles daily, plays golf, keeps up with many Society activities. What is more he fully intends to be present at the coming Annual Meeting in Philadelphia.

When a man can walk several miles a day, play golf, drive a car and look forward to each day with abundant enthusiasm and energy — all at the age of 92 he can be rated a remarkable person.

Just such an individual is C. V. Haynes, Society president in 1934 and oldest living past president, who was visited a few weeks in advance of his 92nd birthday at Framingham, Massachusetts by R. T. Kern, member of Council 1952-55 of Fitchburg, Massachusetts and ASHAE Public Relations Director, W. M. Vidulich.

The visitors were warmly greeted by Mr. Haynes and during the course of a spirited conversation he showed keen interest in the many current activities of the Society.

Recalling that he had served on the Committee which inaugurated publication

***(Below)* Past President Haynes and R. T. Kern, Fitchburg, Mass., talk things over on a recent visit. *(Right)* Long an enthusiastic (and skilled) golfer, Mr. Haynes still gets in his golf game and maintains his perfected grip**

of the first edition of the HEATING VENTILATING AIR-CONDITIONING GUIDE in 1922, he expressed pleasure with the success of this Society endeavor during the past 36 years and commented that the new larger size of the 1959 GUIDE was a very progressive idea.

The conversation then switched to the forthcoming 65th Annual Meeting and 14th International Heating and Air Conditioning Exposition in Philadelphia, January 26-29, 1959. With a big smile and emphatic shake of his head, Mr. Haynes declared that he is going to attend the 65th Annual Meeting and that he is looking forward to seeing many of his old friends.

When he was complimented on his agility and vitality Mr. Haynes shrugged it off by simply saying that as long as one is interested in doing something age makes little difference. It was quite evident that he takes an interest in many things and does not remain idle for very long. He enjoys a long daily walk of several miles, still likes to go out on the golf course and reads all literature and correspondence sent to him concerning the Society. Only recently he wrote a congratulatory letter to one of the newly chartered Chapters of the Society wishing its members success in their venture.

Mr. Haynes was born in Middleburg, New York on December 12, 1866 where he worked with his father from the time he was 10 years old while he progressed through public, high school and business college. He taught school for 2 years before starting on a business career by working as a bookkeeper and traveling salesman for a supply house for more than 5 years. He then spent a number of years with Wm. H. Page Boiler Company and the American Radiator Company before returning to the supply business in Philadelphia under the firm name of Haynes-Thompson Company; later forming Haynes Selling Company; a heating specialty firm. The Haynes Selling Company remained active in manufacturing and sales from 1913 to 1922 at which time it was purchased by the Hoffman Specialty Company and Mr. Haynes became first vice president and general sales manager for the Hoffman Specialty Company. Over a period of many years with Hoffman he traveled from coast to coast contacting wholesalers, their sales personnel and their customers.

An enthusiastic golfer, Mr. Haynes enjoyed nothing better than a pleasant day on the golf course; especially with such friends as former Society officers D. S. Boyden, W. H. Carrier, W. H. Driscoll and Perry West.

Two other hobbies the oldest living past president of the Society enjoyed were farming and flying. By the time he was elected Society President in 1934 he had already traveled most of the United States by air. During those years he also operated a 125 acre dairy farm at Middleburg in his native Scoharie County, N. Y.

Mr. Haynes became a member of the Society in 1917, served as president of the Philadelphia Chapter in 1917 and also was a member of the New York and Washington, D. C. Chapters. He was elected president of the Society in 1934 having served as first vice president in 1933, second vice president in 1932 and as Council member for 8 years. Mr. Haynes was chairman of the Committee on Research in 1931 and a member of this Committee from 1924 through 1926. A member of the Society for 41 years, Mr. Haynes was elected a Life Member by the Council in 1938. He will look forward to hearing from many old friends at his current address: Mr. C. V. Haynes, c/o Mrs. R. V. Meaney, Western Avenue, Sherbern, Massachusetts.

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INTERNATIONAL INSTITUTE OF REFRIGERATION MEETING

A meeting of Commission 6, *International Institute of Refrigeration* was held at the Technische Hochschule in Karlsruhe, October 20-22, 1958, with the *Application of Refrigeration in Chemical Processes Particularly in the Low-Temperature Range*. Eight outstanding papers were presented covering a variety of subjects in this field, and over 50 engineers were in attendance from continental Europe. The U.S. National Committee of the *IIR* was represented by B. H. Jennings, ASHAE Director of Research, who is a vice president of Commission 6. The Society representative on the U.S. National Committee of *IIR* is Vice Pres. A. J. Hess, Los Angeles, Calif., who was not able to be present at the meeting. In addition to the technical sessions of the conference a business meeting of Commission 6 was also held.

A feature was a reception given by the Mayor of Karlsruhe to honor those in attendance at the conference. The accompanying picture shows a group at the reception (*l. to r*): Prof. Dr. K. Nesselmann of the Technische Hochschule, Karlsruhe, vice president of Commission 6 who ar-

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SOCIETY LUNCHEON AT HEATING & A-C CONGRESS IN BRUSSELS

The Congress (see p. 142, October JOURNAL) held in Brussels, September 22-26th, was a great success with a total attendance reaching approximately 500 people. Engineers and scientists were present from most of the European countries and also from North America. A feature of interest to all Society members was a luncheon for the 21 ASHAE members in attendance.

ranged the meeting; R. Thevenot, director, *International Institute of Refrigeration*, Paris; Prof. Dr. Rudolf Plank, *Kaeltetechnische Institut of the Technische Hochschule*, Karlsruhe, vice president of the Executive Committee of *IIR*; B. H. Jennings, Cleveland; and the *Oberburgermeister* of Karlsruhe, R. G. Klotz.

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ACTIVITIES OF SOCIETY CHAPTERS

Some of the Chapters heard excellent technical talks during local Chapter meetings. The talks covered a variety of problems facing the engineering field today. Members of several Chapters also enjoyed talks on non-technical subjects, some of which dealt with the pros and cons of the merger. The 73rd Chapter was chartered at San Diego, Calif. in October. The first fall meeting of the Regions Central Committee was held in Fort Worth.

NEW CHAPTER CHARTERED AT SAN DIEGO, CALIFORNIA

The Charter Meeting of the 73rd Chapter of the Society was held October 15, at the Mission Valley Inn, San Diego, Calif., with about fifty present. Pres. E. R. Queer, University Park, Pa., presented the charter to the newly elected Chapter president, H. A. Smith.

W. O. Stewart, Los Angeles, Calif., regional director of Region 4, opened the meeting and introduced guests including President Queer, 1st Vice Pres. A. J. Hess, Los Angeles, Calif., Assistant Secretary Fred Hofmann, New York, N. Y., and a contingent of 10 members of Southern California Chapter, headed by Bill Biggar, immediate past president of the Chapter, who chartered a bus to attend.

Chairman Stewart introduced 1st Vice President Hess who welcomed the members and guests.

The Role of the Chapter in ASHAE *Operations* was the topic of an address by President Queer who also discussed the merger plan briefly. Neil W. Lamb, long-range planning administrator, Convair Division, General Dynamics Corp., San Diego, Calif., gave an illustrated talk on *Planning for the Fourth Dimension* which was a discussion of planes of the future. Included at the head table was M. S. Jackson, who was given much of the credit for assistance in organizing the new Chapter.

At a brief business session the members approved the Chapter by-laws and voted the following slate of officers: President — H. A. Smith; Vice President — K. N. Flocke; Secretary — G. W. Dunn; Treasurer — R. L. Huntington. Board of Governors: H. J. Swanson, Roy Conrad, R. C. Snow, W. H. Hermes, III.

1st Vice President Hess presented the gavel, gift of the Southern Alberta Chapter, to Chapter President Smith. Assistant Secretary Hofmann presented the record books to Chapter Secretary Dunn.

AT FORT WORTH REGIONAL MEETING

Discussing chapter problems and Society affairs at the Chapters Regional Meeting of Region 6, at the Hilton Hotel, Fort Worth, Tex., October 20, are: (l. to r.) P. N. Vinther, regional director, Region 6; T. B. Romine, Jr., president, Fort Worth Chapter (host chapter); and Society President, E. R. Queer, University Park, Pa.

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Region 6 Holds Special Fall Meeting

The fall Chapters Regional Committee Meeting of Region 4, was held October 20, at the Hilton Hotel, Fort Worth, Tex., with 9 of the 12 Chapters in the region represented. Fort Worth Chapter was host to the meeting. About 30 persons attended. The sessions were opened by T. B. Romine, Jr., president of Fort Worth Chapter, who turned the meeting over to Council Member P. N. Vinther, regional director of Region 6. J. L. Tye was named secretary of the morning session and C. L. Zahn was secretary for the afternoon session.

While there was no formal agenda for the meeting, the morning session was devoted to a report by Director Vinther, on the October 18 Council Meeting, a talk by Director Vinther on *Responsibility of the Society to Chapters*, and a discussion of the ASHAE-*ASRE* Merger Plan.

A noon luncheon featured a program of entertainment by I. B. Hale, chief of security for the Fort Worth Convair Plant, with a pistol shooting act, followed by a talk *Cold Facts on a Hot Subject*, by L. L. Turner, executive assistant to the vice president of Convair. The illustrated talk had to do with Convair's latest aircraft.

A Ladies' Program included morning coffee at the home of Norma Jean Blanke, a tour to some of the points of interest in Fort Worth, a luncheon at the Western Hills, followed by bridge and shopping. Rosemary Romine was chairman of the ladies' events.

The afternoon business session was devoted to a discussion of Chapter problems.

A social hour hosted by Fort Worth Chapter was followed by dinner (Texas-style) at the Hilton, which also was attended by the ladies. The Fort Worth-North Texas Chapters joint meeting followed the dinner after which President Queer discussed *General Activities of the Society*. A feature of the dinner meeting was the presentation to President Queer of a western hat, an honorary citizenship certificate, which was signed by all members of the Fort Worth Council and a deputy sheriff's commission (the real thing!), together with a deputy sheriff's badge.

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Technical Talks

R. S. Harwood, chief engineer, Tuttle & Bailey Pacific, Inc., City of Industry, Calif., presented an extremely interesting and timely talk before members and guests of ARIZONA Chapter. Mr. Harwood's talk on the balancing of high-velocity systems, outlined a system to be followed for best results. A lengthy question and answer period followed. • • • A quick method of designing high pressure duct systems was explained by Elliot Godes, engineer, Anemostat Corporation of America, Hartford, Conn., to members and guests of AUSTIN Chapter. Mr. Godes pointed out that high pressure duct systems are relatively new, but the systems are already accepted and proven. Flexibility, easy balance, space saving and other advantages are offered with high-velocity air distribution systems, he declared. Mr. Godes offered a design method which, he said, is simple, complete and flexible. • • • Members of BATON ROUGE Chapter also heard Mr. Godes speak on *High-Velocity Duct Design.* • • • J. B. Custer, The Trane Co., La Crosse, Wis., spoke on the subject *Plate Fin Heat Exchangers for Air Borne Electronic Cooling Applications,* before members and guests of CENTRAL NEW YORK Chapter. The illustrated talk proved to be interesting and informative. • • • *High-Temperature Hot Water Heating Systems* was the topic of a talk presented to members and guests of JOHNSTOWN Chapter. The speaker, G. F. Carlson, engineer, Bell & Gossett Co., Morton Grove, Ill., pointed out that today, hot water heating systems designed for temperatures up to 250 F are considered low temperature, 250 to 300 F, intermediate temperature and 300 to 400 F, high temperature. He stated that the high-temperature systems are used in place of large steam systems where under certain conditions savings can be made because less equipment is needed. Mr. Carlson then discussed the basic principles of high-temperature systems and their application. • • • Members and guests of KANSAS CITY Chapter heard T. J. Englehardt, Jr., Owens-Corning Fiberglas Corp., summarize the history of the development of glass fiber ducts for use in residential and small commercial applications. A sound movie illustrated how the material can be used in forming ducts in a typical application. The movie was followed by a lively question and answer period. • • • P. P. Foglio, area sales manager, Electronics Corporation of America, Combustion Control Division, New York, N. Y., lectured on the subject *Safe Burning Fuels* before members of LONG ISLAND Chapter. He discussed the importance of automatic control to avert explosions in fuel burning equipment. The talk was interesting as well as instructive. • • • An informative talk was given before members of MEMPHIS Chapter by J. W. May, regional director of Region 5. Mr. May spoke on *The Selection and Application of Air Filters* and brought out that the primary points to consider are initial cost, efficiency requirements and maintenance costs. • • • G. F. Carlson, engineer, Bell & Gossett Co., Morton Grove, Ill., gave a very informative talk on proper pump and tank location and pump selection for water distribution systems. Members of MINNESOTA Chapter enjoyed Mr. Carlson's talk and showed their interest by posing many pertinent questions. • • • Members of NEW MEXICO Chapter heard an instructive talk on fans and their selection for different applications. J. H. McCabe, district manager, American Blower Corp., Denver, Colo., was the speaker for the evening. • • • F. M. Johnson, sales manager, Kathabar Division, Surface Combustion Co., Toledo, Ohio, talked on the subject of Kathabar air conditioning and sterilization, before members of NORTH JERSEY Chapter. An interesting question and answer period followed. • • • A talk on *High-Temperature Hot Water Systems* was presented by Victor Cole, branch sales manager, Carrier Corporation, Oklahoma City, Okla., before members and guests of NORTHEASTERN OKLAHOMA Chapter. Mr. Cole defined the term high-temperature hot water system and explained the advantages of such a system, where it can be used and the present day applications. He also noted several economies of such a system and named a few jobs in Tulsa and the near vicinity which found it beneficial. A discussion period followed the formal presentation. • • • Henry Wright, technical consultant, American Air Filter Co., Inc., New York, N.Y., spoke before members of NORTHERN PIEDMONT Chapter on the subject of *Heating and Cooling Research in Occupied School Buildings.* Mr. Wright used several slides to illustrate his talk and particularly the various instruments and methods used in conducting his research in school buildings throughout the country. Following Mr. Wright's interesting talk there was an enthusiastic discussion of several points brought out in his presentation. At an earlier meeting a discussion of the Burgess Manning Radiant Ceiling System for heating and cooling was led by Joseph Engberg, assistant sales manager, Architectural Products Division, Burgess Manning Co., Chicago, Ill. Mr. Engberg's talk entitled *Radiant Heating, Cooling and Controlled Human Comfort* brought an enthusiastic response from NORTHERN PIEDMONT Chapter members. • • • A very excellent address on the subject of *Three Imperatives for Tomorrow* was given by L. P. Shannon, manager, Extension Division, E. I. duPont de-Nemours & Co., Wilmington, Del. Following Mr. Shannon's talk members of PHILADELPHIA Chapter demonstrated an active interest in a discussion on the merger of ASHAE and *ASRE.* The debate was led by John Everetts, Jr., Council member and former regional director of Region 1. • • • Richard Chapman, Carrier Corporation, Detroit, Mich., presented an interesting talk on *Heating and Air Conditioning of Modern Supermarkets* before members and guests of PITTSBURGH Chapter. A lengthy question and answer period followed Mr. Chapman's talk. • • • Members of SAVANNAH Chapter participated in an interesting discussion on thermal insulation which was led by S. L. North, chairman of the board of North Brothers, Inc., Atlanta, Ga. • • • SOUTH CAROLINA Chapter members and guests heard an enlightening talk on selection and application of pumps for air conditioning, given by Lee Timmerman, Buffalo Forge Co., Buffalo, N. Y. • • • An instructive talk on *High-Velocity Duct Design* was given by Elliot Godes, engineer, Anemostat Corporation of America, Hartford, Conn. The presentation was well received by members of SOUTH TEXAS Chapter. • • • R. A. Beatty, chief metallurgist, Reading Tube Corp., Reading, Pa., led an informal discussion on the *Relationship of Copper Tubing to Heating and Air Conditioning.* Mr. Beatty's talk included comments on the production of copper tubing in the mill for the purity required and why copper has the property of resistance to corrosion. Slides were shown of equipment and production practices in a copper mill. There was considerable discussion with many questions and comments coming from a very enthusiastic WEST TEXAS Chapter audience. • • • Members and guests of WISCONSIN Chapter enjoyed a talk given by Robert Jorgensen, assistant chief engineer, Buffalo Forge Co., Buffalo, N. Y. Mr. Jorgensen's topic was *Fan Design and Application.* The subject proved to be interesting and instructive.

Non-Technical Talks

P. J. Marschall, director of Region 2, spoke before members of CINCINNATI Chapter and clarified many of their problems pertaining to the merger of ASHAE and *ASRE.* • • • INDIANA Chapter members and guests heard an interesting, illustrated talk by Z. A. Marsh, director of school activities, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., on *The Engineer's Responsibility in School Planning.* Mr. Marsh's basic objective is to obtain better schools through air conditioning. Mr. Marsh explained how air conditioning could provide a major improvement frequently at less cost than for non-air conditioned constructions. An extended question and answer period indicated the interest with which his talk was received by members and their guests, several of whom represented school interests. • • • Jack Morris, associate, Lyle, Marque & Assoc., Cons. Engrs., Spokane, Wash. presented a film from the Pacific Telephone and Telegraph Co., on the *Dew Line Story.* The film was very interesting and informative and was enjoyed by all in attendance at the INLAND EMPIRE Chapter meeting. • • • MICHIGAN Chapter members heard F. L. Tarleton, manager, Refrigeration, Hotpoint Corp., Chicago, Ill. and J. N. Livermore, assistant director, Design Engineering Department, Detroit Edison Co., Detroit, Mich. enlighten them on the organizational details of the proposed merger. They also pointed out both the pros and cons which have been raised concerning the merger. • • • *The Economic Advantages of*

Year-Round Air Conditioning was the subject of a talk given by S. A. Gray, regional sales manager, Minneapolis-Honeywell Regulator Co., Dallas, Tex. Mr. Gray's illustrated talk dealt with cost savings brought about by increase in human efficiency and decrease in cleaning and decorating. He showed, by use of average owning cost figures, that only a very slight increase in worker efficiency is necessary to economically justify year-round air conditioning in most applications. Schools were pointed out as a particularly promising field. • • • Members of ONTARIO Chapter heard A. J. Hess, 1st vice president of ASHAE speak on the subject *The Environmental Laboratories for Growing Plants*. Mr. Hess' talk dealt with the experimental work being done all over the world to improve and increase plant growth by means of air conditioning and other devices in view of meeting the ever increasing demand for more food. The talk was illustrated by slides and held the attention of all present. • • • Ray Gillespie, secretary-treasurer of the Colorado Bid Delivery Service of Denver, Colo., explained the features, aims and purposes of this service before members and guests of ROCKY MOUNTAIN Chapter. It promises to be a fine help to the contracting business, he said, by striving to raise standards of the bidding process up to its intended ethical level and eliminating such malpractices as peddling and chiseling. One recommendation was that to better utilize lump bids, engineers arrange all sheet metal specs in one section and not have it spread into a number of different spec sections. • • • Members of SACRAMENTO VALLEY Chapter enjoyed a talk by W. J. Artman, Market Sales Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., on the *Economic Advantages of Clean Air*. The talk was well received by Chapter members.

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HEAT PUMP PROSPECTS

A recent issue of the bi-monthly publication *Business in Brief* put out by Chase Manhattan Bank in New York devotes two pages to the prospects in connection with electric power.

In addition to pointing out that only a very small percentage of homes are now equipped with air conditioners, considerable attention is directed toward the heat pump and the following is a portion of a statement concerning its position and prospects.

At the start of 1958, 23,500 heat pumps had been installed. This is more than 10 times as many as were operating in 1955 and almost double the number in use last year. So far the majority of these are in the South. But as technological improvements increase their efficiency their use is becoming more widespread. How much does a heat pump cost? At present the price runs about 15 to 20 percent more than conventional heating and air conditioning equipment — from $2,500 to $3,000 for a house in the $15,000-20,000 price range. Operating costs depend on the climate and the exact rates charged for electricity. If the heat pump should gain general acceptance, the potential increase in sales of electricity would be substantial. It is estimated that installation of a heat pump in the average home would cause consumption of electricity to shoot up from 3,000 kwh to about 20,000 kwh.

BAAN AT *VDI* MEETING

The Annual Meeting of the Heating and Ventilating Section of the *Society of German Engineers* held October 16-17 in Stuttgart, Germany was attended by George B. Baan, member of the ASHAE International Relations Committee, appointed as official representative to this meeting by Pres. E. R. Queer.

Upon his return to the United States, Mr. Baan reported that the Meeting was well attended by over 850 heating and air conditioning engineers from all over

G. A. Baan *(left)*, Society representative, and G. LaBohm, chairman, Heating and Ventilating Section, at the meeting of *VDI* in Stuttgart

Europe including countries behind the Iron Curtain. As the official representative of the Society he was given an opportunity to address the meeting and, speaking in German, he expressed the interest of ASHAE in the deliberations of their European colleagues and wished them a most successful meeting. The various members of the *VDI*, who were in the United States in June by invitation of the Society, were in attendance at this meeting and they spoke highly of the considerations and cooperation extended to them by ASHAE while they were in the United States.

As a result of their observations and discussions in this country, reports were presented at their Annual Meeting indicating that they are hopeful that heating installation codes and regulations in Germany may be patterned after those now in common use in the United States.

CONFERENCE ON AIR POLLUTION

Meeting on November 18, 19, and 20 in Washington the National Conference on Air Pollution was open to all. Called by the Surgeon General, U. S. Public Health Service, the Conference made use of panel and forum sessions and discussion groups to accomplish its purpose of bringing together persons and groups interested in the whole subject. W.C.L. Hemeon, Pittsburgh, Pa., served as vice chairman of the discussion group assigned to the topic of Control Methods and Procedures, while both Dr. Leonard Greenburg, New York, N. Y. and Benjamin Linsky, San Francisco, Calif., served on the panel of the discussion group covering the subject of Administrative Aspects. As representatives of the Society, Pres. E. R. Queer, University Park, Pa., appointed R. C. Jordan, Minneapolis, Minn., and B. H. Jennings, Cleveland, Ohio.

BRI NOISE CONTROL CONFERENCE

Building Research Institute, Washington, D. C., has announced that it will hold a Noise Control Conference in New York on January 14-15 at the New Yorker Hotel.

Included among the subjects to be dealt with are noise problems which arise because of the use of high-velocity air-conditioning and ventilation systems, together with the use of air duct terminal devices.

The conference is open to the general public and is intended primarily for builders and architects.

It is intended also that the material presented will be aimed at making the subject of noise control more understandable. It is expected that a feature of the program will be a review of experiences to date with noise problems in typical situations.

ADVISORY COMMITTEE FOR EXPOSITION

Announcement has been made of the advisory committee for the 14th International Heating & Air-Conditioning Exposition, to be held under the auspices of the Society at Convention Hall, Philadelphia, January 26-29. E. R. Queer, University Park, Pa., president of the Society, is chairman.

Officers and members of the Society named to the committee are the following: Arthur J. Hess, Los Angeles, Calif, 1st vice president; Walter A. Grant, Syracuse, N. Y., 2nd vice president; John Everetts, Jr., Philadelphia, Pa., Council member; M. F. Blankin, Philadelphia, Pa., past president; H. P. Gant, Glenmoore, Pa., past president; L. N. Hunter, Johnstown, Pa., past president; C. J. Forve, president, Philadelphia Chapter; H. N. Teuber, secretary, Philadelphia Chapter; S. H. Nitzberg, president, North Jersey Chapter; E. J. Busch, president, Pittsburgh Chapter; K. O. Schlentner, president, Johnstown, Chapter; J. K. Thornton, secretary, Johnstown Chapter; J. H. Hucker and R. P. Schoenijahn, honorary chairmen, and E. K. Wagner, general chairman, for the 65th Annual Meeting; F. H. Buzzard, vice chairman for the forthcoming Annual Meeting; C. J. Lubking, chairman Chapter exposition committee; T. F. Rockwell, consulting engineer, Pittsburgh; P. H. Yeomans, consulting engineer, Philadelphia.

Members of the Committee representing trade and professional associations having a direct interest in the field of the exposi-

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tion have also been named to the committee as follows: J. W. Wilcock, president *Air Moving and Conditioning Association, Inc.*; Arnold Arch, president, *Air Pollution Control Association*; J. T. Wolfe, president, *American Gas Association*; J. N. Richards, president, *The American Institute of Architects*; H. H. Allen, president, *American Institute of Consulting Engineers*; Cecil Boling, president, the *American Society of Refrigerating Engineers*; F. W. Earnest, Jr., president, *Anthracite Institute*; K. E. Johnson, president, *Cooling Tower Institute*; R. E. Ferry, New York, N. Y., general manager, *The Institute of Boiler and Radiator Manufacturers*; H. E. Wetzell, president, *Mechanical Contractors Association of America, Inc.*; W. G. Gillim, president, *National District Heating Association*; F. L. Meyer, president, *National Warm Air Heating and Air Conditioning Association*; J. V. Resek, president, *Oil-Heat Institute of America, Inc.*; R. A. Locke, *Steel Boiler Institute, Inc.*; W. B. Baer, president, *Stoker Manufacturers Association.*

TECHNICAL ADVISORY COMMITTEE ON CONTROL APPOINTED

At the Control Conference held at the Laboratory last May, it was decided that a Technical Advisory Committee on Control should be set up in accordance with the procedure of the Committee on Research.

The committee has just now been appointed with the following membership: H. W. Alyea, Milwaukee, Wis., chairman; E. F. Snyder, Jr., Minneapolis, Minn., vice chairman; E. H. Beling, Moline, Ill.; H. F. Brinen, Racine, Wis.; S. F. Gilman, Syracuse, N. Y.; P. B. Gordon, New York, N. Y.; C. A. Gustafson, Skokie, Ill.; L. N. Hunter, Johnstown, Pa.; John W. James, Chicago, Ill.; H. A. Lockhart, Morton Grove, Ill.; J. A. Lofte, Milwaukee, Wis.; W. S. Maxim, Libertyville, Ill.; S. W. Miller, Philadelphia, Pa.; F. B. Morse, Lafayette, Ind.; T. F. Rockwell, Pittsburgh, Pa.; G. L. Tuve, Cleveland, Ohio; W. G. Young, Rockford, Ill.

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CANDIDATES FOR MEMBERSHIP

Listed here are the names of 116 men who are the candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility of receiving these candidates into membership by advising the Executive Secretary before December 31, 1958 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted upon by the Council.

*Note: *Advancement †Reinstatement*

Alabama (*Region* 5)

DUNLOP, HENRY, Design Draftsman, Alabama Dry Dock & Shipbuilding Co., Mobile.

Arizona (*Region* 4)

JONES, C. E., JR., Asst. Prof. Mech. Engrg., University of Arizona, Tucson.

California (*Region* 4)

ADLER, E. H., Retired, Chula Vista.

ANTELLINE, F. F., Pres., Fred F. Antelline, Inc., San Diego.

BONNAR, J. T., Sales Engr., Natural Gas Equipment, Inc., So. San Francisco.

BUCHBERG, HARRY, Assoc. Prof. of Engrg., Dept. of Engrg., University of California, Los Angeles.

DIERKS, D. C., Sales Engr., Minneapolis-Honeywell Regulator Co., San Diego.

FOGLEMAN, S. F., Mech. Engr., Fred F. Antelline, Inc., San Diego.

GARRY, F. A., Engr., Estimator, University Heating & Air Conditioning Co., San Diego

GRAIN, C. R. Design Engr., Fred F. Antelline, Inc., San Diego.

HALL, K. C., Sales Engr., Jackson & Blanc, San Diego.

HERMES, W. H., III†, Cons. Mech. Engr., San Diego.

KINDELON, E. F., Sales Engr., Powers Regulator Co., San Diego.

NEILD, W. H., Indus. Gas Sales Engr., San Diego Gas & Electric Co., San Diego.

RICH, M. D., Sales Engr., Fraser & Johnston Co., San Francisco.

SHABAN, H. A., Engr., Welton Becket & Assocs., Los Angeles.

SMITH, S. J., Mech. Engr., Frank L. Hope & Assoc., San Diego.

STRUM, MERLE, University Mechanical & Engineering Contractors, San Diego.

STUDER, G. H., Sales Engr., Allied Refrigeration Suppliers, Inc., San Diego.

TAKAHASHI, ICHIRO*, Chief Engr., Kilpatrick & Co., Alhambra.

VON GOTTBERG, ROY, Chief Estimator & Bus Mgr., Fred F. Antelline, Inc., San Diego.

WILL, D. S., Pres., Southland Heating & Air Cond. Inc., Long Beach.

Colorado (*Region* 3)

RECEN, CLYDE, Htg. Supt., Bell Plumbing & Heating Co., Denver.

Illinois (*Region* 2)

DUBIN, H. C.*, Mech. Engr., Naess & Murphy, Chicago.

HEINLEIN, G. C., Owner, Heating and Ventilating Equipment, Chicago.

NITZ, R. J., Repr., Jenkins Bros., Chicago.

REILLY, W. A., Sales Engr., Johnson Service Co., Chicago.

SCHAIBLE, K. C.†, Field Engr., Powers Regulator Co., Skokie.

Kansas (*Region* 3)

NEVIN, J. W., Design Engr., Burgwin & Martin, Topeka.

Louisiana (*Region* 5)

RUSSO, A. F., JR., Design Engr., Cary B. Gamble & Assoc., New Orleans.

Maine (*Region* 1)

WIENER, M. A., Field Engr., Lewiston Supply Co., Lewiston.

Maryland (*Region* 5)

MULLER, H. G. JR., Br. Mgr., Barber-Colman Co., Bethesda.

Massachusetts (*Region* 1)

CALL, D. H. Design Engr., A. Ehrenzeller, Inc., Dorchester.

FALVEY, W. J.†, Cons., Sylvania Electric Products, Inc., Danvers.

GREENHALGH, R. B., Owner, Ralph Greenhalgh Heating & Electrical Contractor, Westport.

MCCARTHY, H. R., Pres. & Treas., R & M Heating & Air-Conditioning Co., Inc., Waltham.

MITCHELL, B. B., Owner, The Mitchell Co., Fall River.

SESTITO, J. F. J., Mech. Engr., Lockwood Greene, Archt.-Engrs., Inc., Boston.

Michigan (*Region* 2)

DEANNA, W. A., Htg. Sales Engr., Warren Plumbing Supply Co., Detroit.

FERRIS, D. R., Vice Pres., Engrg., Kysor Heater Co., Cadillac.

GIMPEL, N. H., Mgr. Htg. Dept., Warren Plumbing Supply Co., Detroit.

SPRENGER, C. B., Supvsr. Engr., The Detroit Edison Co., Detroit.

Minnesota (*Region* 3)

JAIN, P. C. Teaching Asst., Dept. Mech. Engrg., University of Minnesota, Minneapolis.

RUPP, D. C., Vice Pres. in charge of Sales, The Mammoth Furnace Co., Minneapolis.

Mississippi (*Region* 5)

RAMSEY, G. B. III, Owner, George B. Ramsey, Engr., Starksville.

Missouri, (*Region* 3)

BATTMER, G. A., Partner, Battmer & Rider Co., Kansas City.

BROWN C. A. Indus. Engr. Laclede Gas Co., St. Louis.

DART, D. M., Asst. Div. Mgr., Refrigerants Div., The Marley Co., Kansas City.

JACOBSON, H. R.*, Vice-Pres., Treas., A. D. Jacobson Plumbing & Heating Co., Inc., Kansas City.

KOHL, C. A., Sales Engr., Westinghouse Electric Corp., St. Louis.

LEINBERGER, R. C.†, Assoc. Sales Engr., R. R. Waites Co., St. Louis.

LISSANT, J. H., Engr., Connors Heating & Air Conditioning Co., St. Louis.

MINTON, J. W., Engr., Estimator, Connors Heating & Air Conditioning Co., St. Louis.

PATTERSON, R. W., Mfrs. Repr., Kansas City.

REGAN, C. J., Sales Engr., Kewanee Boiler Div., American Standard, Kansas City.

RIDER, W. E., Partner, Battmer & Rider Co., Kansas City.

SHACKLETON, A. K., Sales Engr., National-U. S. Radiator Corp., St. Louis.

WRIGHT, J. K., Regional A-C Engr., J. C. Penney Co., Inc., Kansas City.

New Jersey (*Region* 1)

GOTWALS, R. D., Htg. & Cooling Repr., American Radiator & Standard Sanitary Corp., Camden.

STEINKE, B. J.*, Cons. Engr., Dwight Engineering Assocs., Englewood.

New York (*Region* 1)

BOWMAN, J. L., Ensign United States Naval Reserve, New York.

CLAUSEN, O. W. Research Engr., Carrier Corporation, Syracuse.

DEMMERLE, LESTER, Plbg. & Htg. Contr., Brooklyn.

DOUGLAS, WILLIAM, JR., Chief Mech. Engr., Metcalf & Eddy, New York.

GELBER, DANIEL, Sales Mgr., Oil Heat Engineering Co., Inc., New York.

HARRIS, G. B., Mech. Engr., Wheelus Air Base, New York.

TRAINA, J. A., Sales Engr., Tri-State Heating & Ventilating Corp., Farmingdale.

VRADENBURGH, D. F., Htg., Vtg., A-C. Designer, John Graham & Co., New York.

WILLIAMS, SY*, Chief Engr., H. Klein & Sons, Inc., Mineola.

North Carolina (*Region* 5)

BLOUNT, H. A. JR., Project Engr., Air Conditioning Corp., Greensboro.

CHEEK, G. H.†, Com. A-C. Supvsr., Appliance Promotion Dept., Duke Power Co., Charlotte.

Ohio (*Region* 2)

DORN, J. D., Sales Engr., John J. Nesbitt, Inc., Dayton.
HERSHEY, W. F. JR.*, Br. Mgr., National-U.S. Radiator Corp., Cincinnati.
OETJEN, J. E., Staff Engr., H. K. Ferguson Co., Cleveland.
SULLIVAN, DALLAS*, Sales Engr., Johnson Service Co., Cincinnati.
WILKIE, J. E.*, Sales Engr., F. C. Richardson, Jr., Toledo.

Oklahoma (*Region* 6)

SHOEMAKER, R. F.*, Engr., Forrest Shoemaker Air Conditioning Co., Tulsa.

Oregon (*Region* 4)

ATKINSON, R. R.†, Mfrs. Repr., Martigs, Inc., Portland.
DALY, E. A., Asst. Prof., Mech. Engr. Dept., Oregon State College, Corvallis.
DEVINE, D. F.*, Htg. Engr., Northwest Natural Gas Co., Portland.
MCWILLIAMS, R. L., Owner, Gresham Plumbing & Heating, Inc., Gresham.

Pennsylvania (*Region* 1)

GAAB, W. J., Sales Engr., Weber Air Conditioning Co., Pittsburgh.
HARTWIG, C. H., Sr. Appl. Engr., West Penn Power Co., Greenburg.
KOLB, J. T., Draftsman, Weber Air Conditioning Co., Pittsburgh.
MILLER, W. A., Mgr., Vtg. Dept., H. H. Robertson Co., Pittsburgh.
WARFEL, E. C., Engr., National-U. S. Radiator Corp., Johnstown.
WEBER, J. E., Genl. Mgr., Weber Welding Supply Co., Pittsburgh.

Rhode Island (*Region* 1)

HARTLEY, R. A., Chief Engr., American Moistening Co., Providence.
JOHNSON, W. E., Mgr. of National Accounts, Taco Heaters, Incorporated, Cranston.
WILKINSON, R. E., JR., Design Engr., Buerkel & Co., Inc., Providence.

South Carolina (*Region* 5)

POWELL, H. H., Dist. Sales Mgr., Stewart-Warner Corp., Heating & Air Conditioning Div., Greenville.
WYNN, J. L., Owner, J. L. Wynn & Co., Inc., Greenville.

Texas (*Region* 6)

ALBRECHT, CLARENCE, Estimator, Herlin Engineering Co., El Paso.
ASCHERL, J. L., Div. Engr., Board for Texas State Hospitals & Special Schools, Austin.
CRONK, A. E., Engr., Anthony Co., Lubbock.
MCCAIN, G. F., JR., Br. Com. Sales Mgr., Minneapolis-Honeywell Regulator Co., Houston.
MOSS, L. B., JR.†, Sales Engr., McMillan Equipment Co., Houston.
ROBBINS, A. L., Repr., Ramsey & Robinson Houston.
WRIGHT, W. F., Utilization Dir., Southern Union Gas Co., Dallas.

Utah (*Region* 4)

BROWN, T. R., Pres. & Gen. Mgr., Refrigeration Distributors Corp., Salt Lake City.
CONFAIR, B. D., Br. Mgr., Industrial Service & Engineering Co., Salt Lake City.

Wisconsin (*Region* 2)

JAYE, THEODORE †, Sales Engr., Ed Grifford & Co., Milwaukee.
SPRADLING, J. W., Product Engr., Carnes Corp., Verona.

Canada (*Region* 7)

COOK, W. B., Sales Mgr., H. Potter Associates, Ltd., Toronto, Ont.
DOYLE, C. M., Pres., Clare Doyle, Ltd., Vancouver, B. C.
HARDER, H. A., Estimator, E. H. Price (B.C.), Ltd., New Westminster, B. C.
HAYHOE, G. M., Pres. & Managing Dir., E. M. Hayhoe Plumbing & Heating, Ltd., Red Deer, Alta.
KERN, J. D., Mgr., Htg. Dept., R. J. Cave & Co., Ltd., Vancouver, B. C.
MCKENZIE, R. B., Designer, Lethbridge, Alta.
MCLEOD, W. C.*, Mgr., Lloyd A. Book, Ltd., London, Ont.
ROSS, A. F. C., Sales Mgr., Clayburn Harbison, Ltd., Vancouver, B. C.
SHERGOLD, N. J., Mgr., Norris Warming Canada, Ltd., Montreal, Que.
SNYDER, C. E., Estimator, H. D. Layfield & Co., Vancouver, B. C.
SUTTLE, E. J., Pres., Vanco Products Ltd., Vancouver, B. C.
THRING, E. H.†, Sales Mgr., Holmes Foundry, Ltd., Vancouver, B.C.

JOURNAL SECTION

London

HEREFORD, C. J., Dir., Carrier-Ross Engineering Co., Ltd., London.

Venezuela

FRANKLIN, W. M., Director, Franklin & Patta, Ingenieros S.A., Caracas.

OBITUARIES

HAROLD L. ALT
West Palm Beach, Fla.

Harold L. Alt, pioneer in air conditioning and heating, and Society Life Member, died October 15 in West Palm Beach, Fla., where he has resided since his retirement.

Mr. Alt, a native of Rochester, N. Y., entered the engineering profession immediately following his graduation from Rochester Athenaeum and Mechanics Institute. In 1918, he travelled to China where he worked as a consulting engineer for nearly eight years. While in the Orient, he introduced vapor heating into China, where it was previously unknown. In 1926 he was appointed technical editor for *The Heating and Ventilating Magazine* in New York City. Mr. Alt also spent six months in Russia in 1929 as a consulting mechanical engineer.

A Society member since 1913, Mr. Alt is the author of numerous technical articles which have appeared in the Society's JOURNAL and TRANSACTIONS.

Active in chapter activities, Mr. Alt held the office of New York Chapter vice president, president, and member of the board of governors in 1932, 1933 and 1934, respectively. He was also a member of *ASSE, SAME, WCK* Alumni Association, and an Honorary Member of Eugene Field Society of Authors and Journalists.

REINER P. BON
Milwaukee, Wis.

Reiner P. Bon, owner of the Bon Heating Co., Milwaukee, died September 19.

Mr. Bon was born in Albona, Yugoslavia. After completing his education, he came to this country where he entered the heating and ventilating field. His first engineering project was as an employee of the Illinois Steel Co. In 1927 he organized the Bon Heating Co., working on residential, commercial and industrial projects. Mr. Bon became a Society member in 1950.

RAYMOND P. BABCOCK
Newton, Conn.

Raymond P. Babcock, manufacturer's representative from Newton, Conn., died September 22.

Born in Watertown, Conn., Mr. Babcock attended local schools before entering the engineering profession. He worked for many years in the field of management with various heating firms.

Mr. Babcock joined the Society in 1948. He also held membership in the Centennial Lodge, AF & AM of New Britain.

Surviving are his wife, Mrs. Ruth Henry Babcock, a daughter, and two grandchildren.

ALBERT B. MARTIN
Iowa City, Iowa

Albert B. Martin, former president of the Illinois Chapter of the Society, and a Life Member since 1949, died September 27.

Mr. Martin was born in Galesburg, Ill. where he entered the heating and ventilating business with the firm of Lewis & Kitchen. He became associated with the Kewanee Boiler Corp. in 1914, and was a member of its board of directors shortly before the company became a division of the American Radiator and Standard Sanitary Corp. With this firm, Mr. Martin served as branch manager in Minneapolis, and then in Chicago, until his retirement.

Mr. Martin became a member of the Society in 1916. He also belonged to the Rotary Club of Chicago and the Masons.

He is survived by his widow, one son, two grandchildren and a great-grandchild.

HOWARD F. McCANDLESS
Fresno, Calif.

Howard F. McCandless, owner of a consulting engineering firm in Fresno, Calif., died August 30.

A Society member since 1945, Mr. McCandless was born in Ellensburg, Wash. He attended the Carnegie Institute of Technology before accepting a commission in the U. S. Army. He then worked in the field of refrigeration in sales and management, specializing in the development of freezing methods. In 1947, he established his own consulting engineering firm.

A member of *ASRE* and the *American Society for Metals*, Mr. McCandless is survived by his widow who resides in Fresno.

AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS

Headquarters Office
62 Worth St., New York 13, N. Y.
Tel: BArclay 7-8262

(For names of Society Officers see p. 126)

Research Laboratory
7218 Euclid Ave., Cleveland 3, Ohio
Tel: UTah 1-6161

The Standards Committee, Its Subcommittees and Representatives

The Standards Committee considers all scientific matters pertaining to codes and standards, and operates under the direction of the Council. It appoints standards subcommittees as necessary, and society standards representatives on joint committees and on committees formed by other organizations.

ASHAE Standards Committee

P. N. Vinther, *Chairman;*
A. B. Algren, K. T. Davis, Albert Giannini, Fred Janssen G. B. Priester.

Standards Subcommittees

ASHAE Committee on Minimum Outdoor Air Requirements for Air Conditioned Spaces: Albert Giannini, *Chairman*, C. B. Gamble, R. A. Gonzalez, W. J. McConnell, M.D., R. J. Salinger, H. G. Strong.

ASHAE Committee on Revision of Standard for Testing and Rating Return Line Low Vacuum Heating Pumps: W. M. Wallace, II, *Chairman*, H. E. Adams, H. S. Bean, A. H. Church, L. M. Nechine, E. G. Keller, A. O. Roche, Jr., D. H. Whittington.

ASHAE Committee for Review of Standard Test Code for Air Moving Devices: S. Konzo, *Chairman*, L. G. Seigel, G. L. Tuve, D. D. Wile.

ASHAE Committee on Revision of Code for Testing and Rating Unit Ventilators: J. W. McElgin, *Chairman*, L. A. Cherry, A. F. Hubbard, D. H. Kranz, L. G. Miller.

ASHAE Committee on Guidance for Members in Preparation of Local Codes: H. G. Strong, *Chairman*, J. R. Chamberlain, K. T. Davis, C. L. Grandstaff, W. G. Martin, Jr., H. B. Nottage, C. H. Randolph, A. L. Wales.

ASHAE Committee on Test Standard for Testing and Rating Gravity Type Roof Ventilators: Linn Helander, *Chairman*, G. C. Breidert, F. N. Calhoon, R. B. Engdahl, W. V. Hukill, J. P. Johnson, K. E. Robinson, F. B. Rowley, L. J. Shumaker.

ASHAE Committee on Test Standard for Evaluating Air Cleaning Devices for General Ventilation: P. R. Achenbach, *Chairman*, W. C. L. Hemeon, R. F. Logsdon, P. E. McNall, R. J. Salinger.

ASHAE Committee on Test Standard for Sorbent Type Dehumidifiers: G. C. F. Asker, *Chairman*, E. S. Howarth, H. L. Barnebey, W. P. Cummings, W. E. Emley, Jr., R. J. Getty, R. R. Goll, T. E. Gravenstreter, Anthony Hass, G. A. Kelley, E. R. McLaughlin, R. M. Milton, H. E. Parker, W. L. Ross, G. L. Simpson.

ASHAE Committee on Code for Testing Heavy Duty Furnaces and Direct-Fired Unit Heaters: E. K. Campbell, *Chairman*, Bowen Campbell, A. P. Loeb, C. J. Low, W. J. MaGirl, B. F. McLouth, F. L. Meyer, L. G. Miller, A. A. Olson, H. A. Pietsch, O. J. Ress, H. A. Soper.

ASHAE Committee on Code for Testing and Rating Evaporative coolers: R. S. Ash, *Chairman*, S. F. Duncan, H. S. Dutcher, E. F. Gritton, Leo Hungerford, C. B. Rowe, W. T. Smith, J. R. Watt.

Society Standards Representatives

On Joint Committees with Other Organizations

Committee on Standard for Comfort Air-Conditioning (ASHAE, *ASRE, USPHS, ARI*): W. L. Fleisher, *Chairman*, and O. W. Armspach. *Also members-at-large:* M. K. Fahnestock, P. J. Marschall, G. E. May, A. B. Newton.

***ASRE*-ASHAE Joint Standard on Rating and Testing Air Conditioning Equipment with Respect to Sound:** C. M. Ashley, R. D. Madison, A. F. Hubbard.

***ASRE* Task Committee for Revision of Methods of Rating and Testing Air Conditioners:** H. T. Gilkey, L. G. Miller, *alternate*.

On *ASA* Sectional Committees

A-13 — **Scheme for Identification of Piping Systems:** Harry H. Bond.

A-53 — **Building Code Requirements for Light and Ventilation:** John G. Eadie, Myron C. Beman, *alternate*.

A-62 — **Coordination of Dimensions of Building Materials and Equipment:** A. W. Knecht.

A-114 — **Application Standards for Thermal Insulating Materials:** M. W. Keyes, *Chairman*.

B-211 — **American Standard for Pipe Threads:** L. L. Munier.

B-9 — **Safety Code for Mechanical Refrigeration:** Lee Nusbaum, W. W. Grear, *alternate*.

B-16 — **Standardization of Pipe Flanges and Fittings:** L. L. Munier. **Subcommittee No 9 on Solder-Joint Fittings:** L. J. LaTart.

B-31.1 — **Code for Pressure Piping-Subcommittee for Revision of Section 5 Refrigerant-Piping:** S. I. Rottmayer.

B-53 — **Standard Refrigeration Nomenclature:** H. J. Ryan.

B-76 — **Industrial Cooling Towers:** Paul A. Bourquin.

S-1 — **Acoustics:** R. D. Madison, Paul D. Close, *alternate*.

Y-1 — **Abbreviations; Y-10 — Letter Symbols:** R. W. Roose, Carl H. Flink, *alternate*.

Y-14 — **Drawings and Drafting Room Practice:** F. Honerkamp.

Y-32 — **Graphical Symbols and Designations:** E. H. Munier, Carl H. Flink, *alternate*.

Z-9 — **Safety Code for Exhaust Systems:** W. M. Wallace II, W. S. Bondy, *alternate*.

Z-11 — **Petroleum Products and Lubricants:** Bruce L. Evans.

Z-62 — **Uniform Industrial Hygiene Standards:** Allen D. Brandt.

Z-74 — **Fundamentals of Performance of Effluent Air and Gas Cleaning Equipment:** K. E. Robinson.

On *ASTM* Committees

Thermal Insulating Materials: F. B. Rowley, E. R. Queer, *alternate*. **Thermal Insulating Materials Planning Committee:** E. R. Queer.

Acoustical Materials: A. W. Knecht.

Gaseous Fuels: E. A. Norman, Jr.

Atmospheric Sampling and Analysis: M. G. Kershaw.

On *NFPA* Committees

Hospital Operating Rooms: R. P. Gaulin, N. Glickman, *alternate*.

On *American Concrete Institute* Committees

No. 332 — **Recommended Practice for Residential Concrete Work:** W. P. Chapman, R. L. Maher, *alternate*.

Society Organization Personnel

General Committees: The By-Laws provide for 9 such committees. The latest list appears in the July, 1958 issue on page 148

Research Committees: The research program is under the guidance of the Committee on Research — a General Committee. The Committee on Research appoints its Technical Advisory Committees as needed. The 1958 personnel appears in the November, 1958 issue on page 172

Standards Committee: The 1958 personnel appear above.

Special Committees: At present there are 9 of these committees. The latest listing appears in the July, 1958 issue on page 148

Nominating Committee: The committee's membership is fixed by the By-Laws. The latest listing appears in the July, 1958 issue on page 148

Society Regional Organization: The 1958 listing of the names of the Regional Directors and of the members of the Chapters Regional Committees was published in the May, 1958 issue on page 194

Society Chapters and Branches: The Society has chartered 72 Chapters, 1 Overseas Branch, and 6 Student Branches. These groups elect their officers and governing boards. A list of the presidents and secretaries was published in the October, 1958 issue on pages 145, 146

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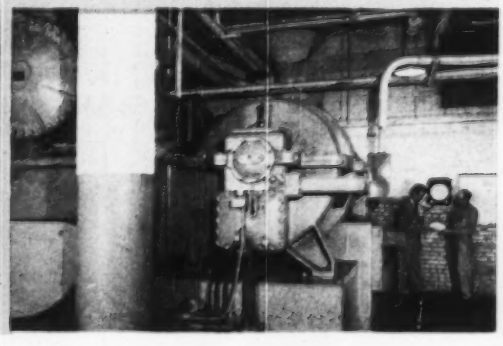
"After 35 Years, one of our Powers temperature control systems is still giving dependable service" . . . reports Mr. Joseph Forster in charge of heating and air conditioning equipment. 1923 model thermostat is shown below. Photo at right shows refrigeration compressor regulated by Powers Temperature Recording Controller. (d-5)



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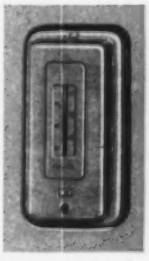

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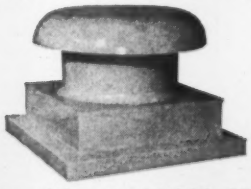

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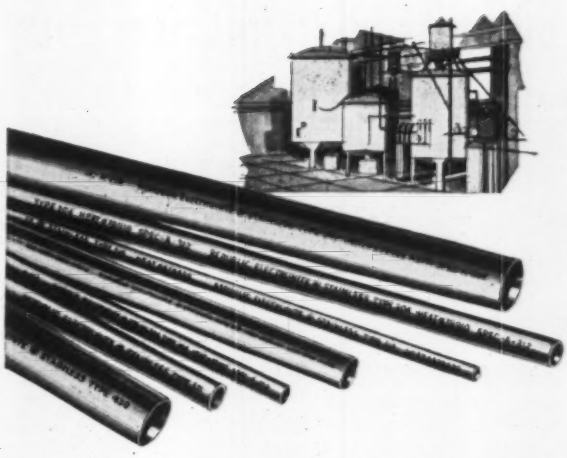

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McJunkin Corp., Atlanta

ILLINOIS
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Creamery Package Co., Chicago (Sanitary Tubing only)

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Williams and Company, Inc. Louisville

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Marsh Steel Corp., North Kansas City

NEW JERSEY
A. B. Murray Co., Inc., Elizabeth

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W. A. Case & Son Co., Inc., Buffalo
Peter A. Frasse and Co., Inc., Buffalo
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K. & S. Metal Supply, Inc., Long Island City

OHIO
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Williams and Co., Inc., Cincinnati
Williams and Co., Inc., Cleveland
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A. B. Murray Co., Inc., Bristol
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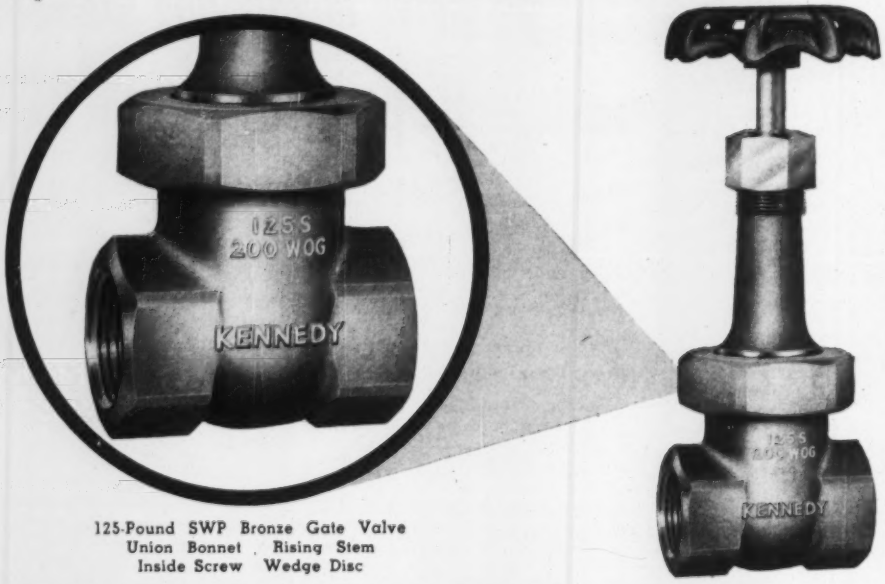
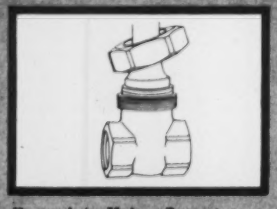
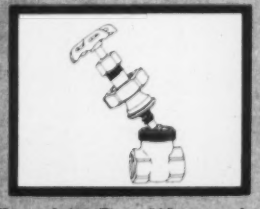


125-Pound SWP Bronze Gate Valve
Union Bonnet Rising Stem
Inside Screw Wedge Disc

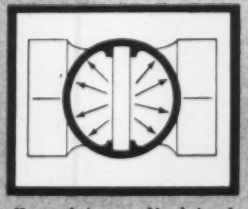
Fig. 525



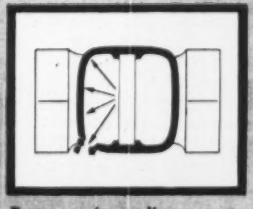
Kennedy's Union Bonnet permits repeated dismantling for cleaning or inspection and reassembly without danger of distortion of the valve. The bronze-to-bronze construction makes a tight union for tight, leakproof operation.



Kennedy's Fig. 525 can be easily disassembled into component parts for installation in otherwise inaccessable places in existing lines or for new installations.



Kennedy's cylindrical body construction when under severe pressure resists rupture and minimizes deflection thus preventing leakage at the seat.



Pressure in ordinary non-cylindrical valve bodies tries to push the body wall out to form a circle or cylinder. Rupturing stresses concentrate where wall has the shortest radius. Resultant deflection causes leakage over disc and early failure.

These additional advantages make KENNEDY your best valve buy...

Rugged, wider hex ends, blended into body, prevent distortion. On a conventional valve body, hex ends protrude from the body and are connected by thin body wrists. This area under severe wrench pressure, can distort and cause disc seating trouble. Kennedy's wider hex ends are blended into the body making the body and hexes one unit. In this way wrench pressure can be absorbed.

Newest in the valve field . . . best in the valve field . . . Fig. 525 gives greater strength with less bulk and weight than any comparably rated valve.

Kennedy's Fig. 525 can be repacked under pressure, eliminating line shut-downs. You simply open valve fully, remove packing nut and then repack.

• *YOU CAN'T BUY A BETTER VALVE THAN A KENNEDY!*

KENNEDY VALVE MFG. CO.

1607 East Water St. ELMIRA, NEW YORK

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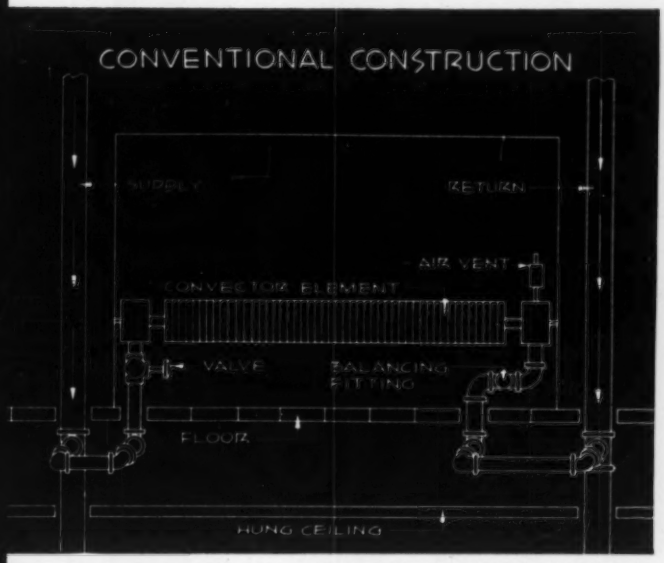
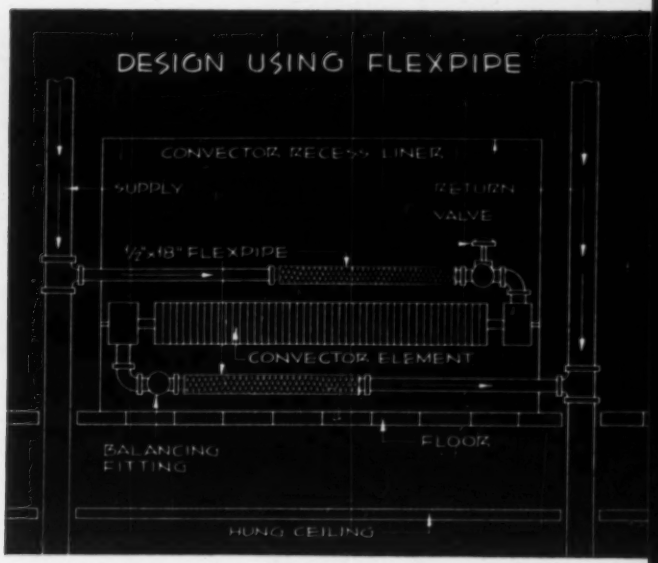
APPLICATION HINTS:

Ways to simplify construction and cut costs with Flexpipe®





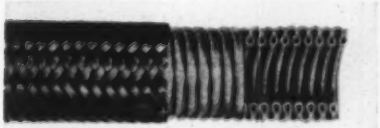
St. Charles Hospital, West Islip, N. Y. Architect and Engineer: Crow, Lewis & Wick, New York, N. Y.
Heating, Ventilating and Air Conditioning Contractor: H. Sand & Co. Inc., New York, N. Y.

Flexpipe connectors in hospital heating system eliminate through-floor convector connections

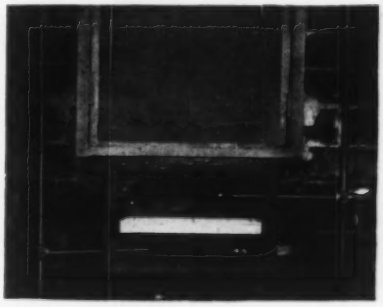
THE PROBLEM: The architectural engineers and contractor for the St. Charles Hospital, West Islip, L. I., were faced with no special technical problems in the two-pipe forced down-feed hot water heating system. They simply wanted to provide maximum floor space and keep total installed costs at a minimum. Had they followed conventional practice, they would have connected the convectors as shown in the sketch at the left, above. This would have involved sleeves through the floor for the stubs to the convectors – making connections overhead in the hung ceiling from a staging on the floor below, furring out walls to get space for making all the connections.

THE SOLUTION: By making connections in the convectors with Flexpipe (see sketch at right, above), the job was greatly simplified. Extreme accuracy was not essential in roughing-in because Flexpipe takes care of offsets and riser expansion. The piping hugs the wall leaving only enough space to accommodate insulation, for minimum loss of floor space. The radiator valves are located where they can be easily reached through access doors. The installation time and material cost of making through-floor connections were eliminated. And the final installed cost was lower than with the conventional method.

WHERE TO BUY. Flexpipe connectors come in convenient standard sizes from ¼ inch through 2 inch, and are sold by leading distributors. They can show you samples and answer questions about service applications. For the name and address of the one serving your area, or for more detailed information, write to: The American Brass Company, American Metal Hose Division, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5822S Rev.



FLEXPIPE has core of seamless tin bronze tubing corrugated for flexibility. No packing. 100% tight. Tin bronze wire braid covering for extra strength. Brass fittings attached. Packaged in clear, tough polyethylene bag for easy identification, handling and warehousing. Above, right: Piping and convector in place at St. Charles Hospital before being furred in, showing location of Flexpipe connectors.



Flexpipe® an **ANACONDA®** product
made by The American Metal Hose Division
of The American Brass Company

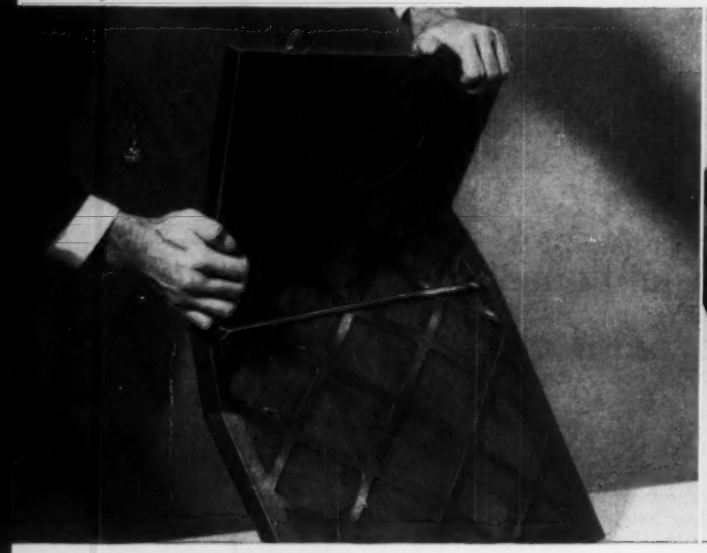
PROVE IT TO YOURSELF

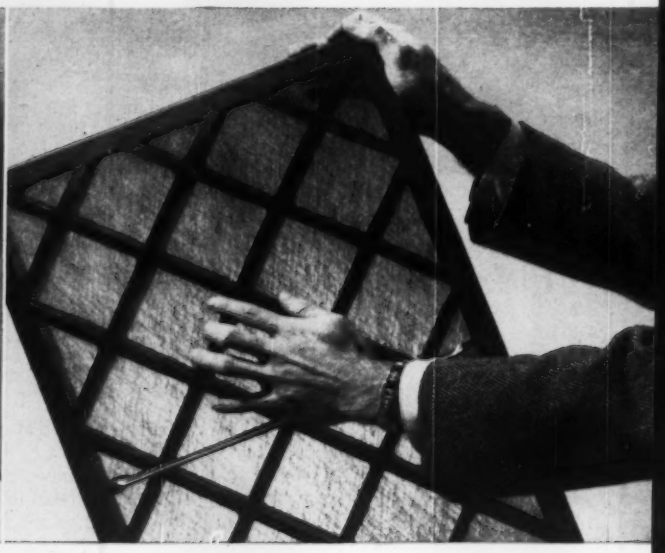
...how much stronger...how much safer

Glasfloss* fiber glass Safety-Grille* filters really are

*TRADE MARK

MAKE THESE TESTS...





1. Bend it—and the new Glasfloss Safety-Grille Filter bounces right back to its original shape. Old type metal-grille filters don't. Unless you re-bend them, they stay bent out of shape and can cut down filtering efficiency. Strong construction of Glasfloss Safety-Grille Filters means less chance of damage in transit, in storage, in handling.

2. Feel the grille edge—it's chipboard, and perfectly safe! No sharp edges—no cuts, no scratches to worry about!

For maintenance personnel, the new Glasfloss Safety-Grille eliminates any danger of cut hands or wrists and possible infection when changing filters.

Plus these features... Glasfloss Safety-Grille Fiber Glass Filters . . .

—have same available filtering area and initial pressure drop as old-type filters
—are tested and proven in service
—are approved by Underwriters' Laboratories, Inc.

Make these tests: Try PPG's new Glasfloss Fiber Glass Safety-Grille Filters in your heating and air conditioning systems. Get top filtering results! They're available in a complete range of sizes from your local distributor or PPG Warehouse.

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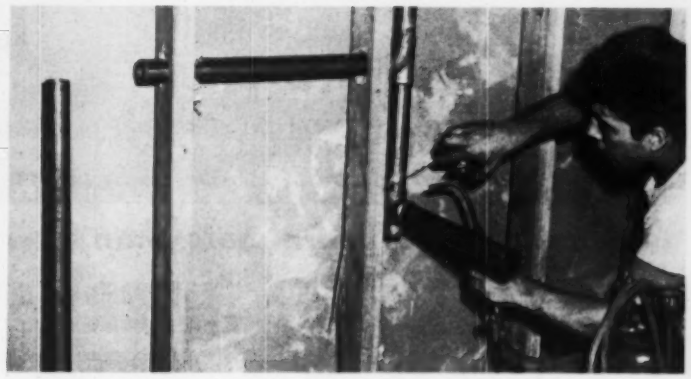
FIBER PG GLASS PITTSBURGH PLATE GLASS COMPANY

Why Bridgeport Copper Drainage Tube-DWV Can Save Up to $80 Per Job

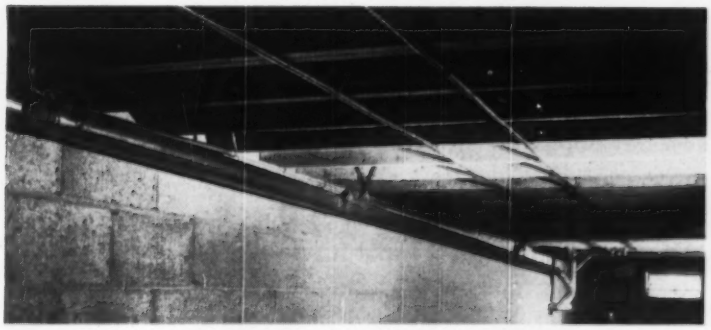
In every step of the job, Bridgeport Copper Drainage Tube—DWV saves time, cost and labor. Savings on an average 1½-bath, 7-room ranch house can run as high as $80. Ask your wholesaler for Bridgeport DWV for all your drainage, waste and vent installations.

Lighter Weight makes DWV easier to handle, faster to install. A 20-foot length of 3 in. tube weighs only 34 pounds.

Easier Fabrication—Bridgeport DWV can be installed with only a few light, easily portable tools. Sub-assemblies can be made at the site or in the shop and brought right to the job.



Faster Installation—Solder joints can be made in a fraction of the time of a caulked or threaded joint. They are permanent and leakproof.



Longer Lengths eliminate extra fittings and joints—speed installation. There are no shoulders in joints to cause clogging.

More Compact—No wrench space required. No beefing up walls. Here a complete Bridgeport DWV installation fits in a standard 2 x 4 in. wall. It serves two bathrooms and a washing machine.

BRASS Bridgeport CO.

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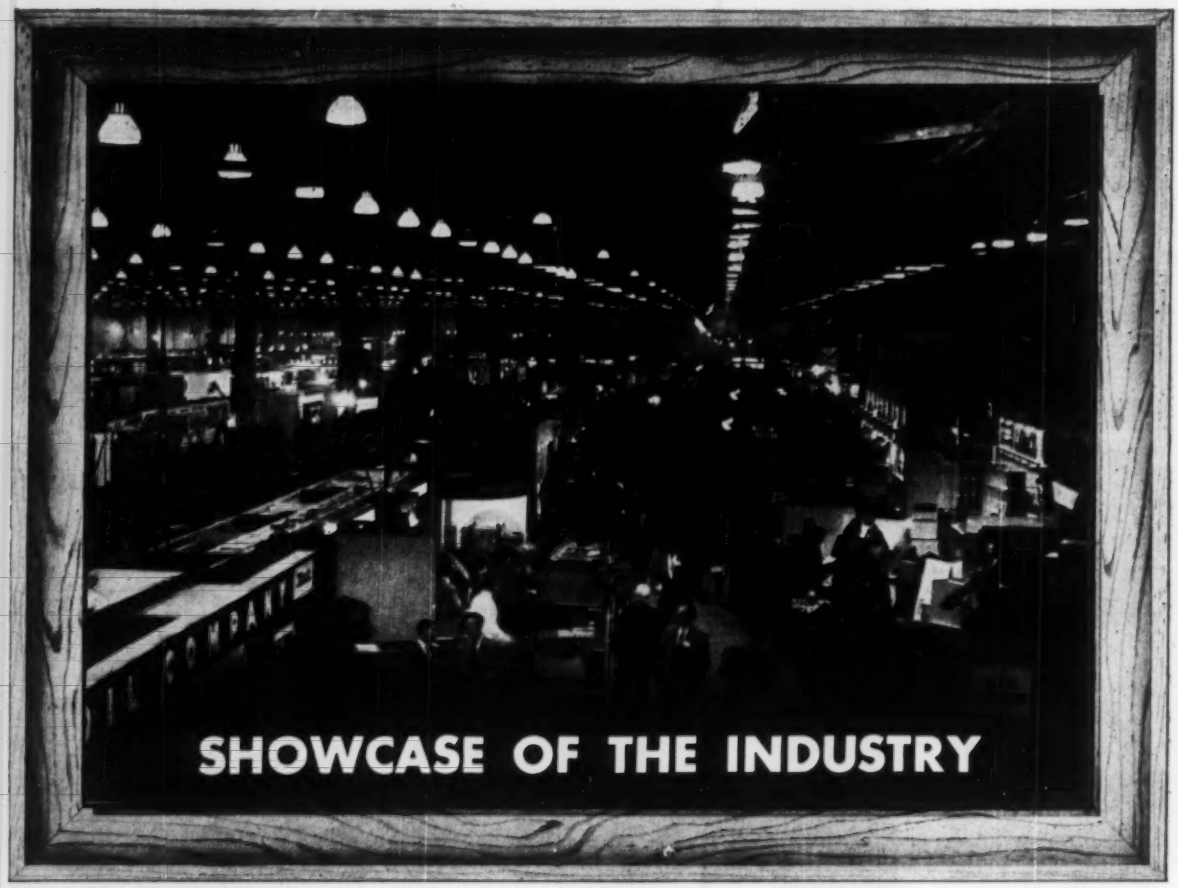

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1262

Field reports about AIR CONDITIONING

Successful installations using Freon refrigerants*

335-ton zone system uses package units for economy and flexibility at Miami Motel

Keeping guests comfortable through days and nights of varied resort activities—and to do it efficiently and economically—was the air conditioning problem at the Beau Rivage Motel, Miami Beach, Florida. Careful study of motel's activity schedule by owner Jack Mintzer and contractor Tom Gerard (shown left to right, above) with their distributor, Marshall Berkson, of Air Conditioning Distributors, Inc., led to installation of a 335-ton system using Westinghouse Packaged Units. One unit is installed on each of the seven separate wings of guest rooms. Air modulator in each room (shown right) allows guests to control cooling for individual comfort. Public areas get cooling from their separate packaged units.

Because output in each unit can be regulated to meet cooling requirements in its area, shifting cooling loads throughout motel can be satisfied economically. In addition, air conditioning can be shut off in unused areas during slack periods. If any unit should fail, the breakdown can be confined to unit involved without affecting entire system.

Package unit system for resort motel sparks new Miami installations

Solve one motel comfort cooling problem in your area, and you may be able to trigger off a whole new series of profitable air conditioning installations. That's what happened at the Beau Rivage

Motel in Miami, Florida, where the big problem was maximum flexibility at minimum cost. The system of Westinghouse Package Units installed by contractor Tom Gerard, of Miami Air Conditioning Company, provided economical comfort cooling for areas ranging from guest rooms where the load was fairly constant to a large supper club with widely varying load conditions. The installation was so successful that several other Miami motels and hotels are planning similar systems.

If flexibility and economy are your air conditioning problem, why not consider this type of system?

For dependable performance, specify "Freon" premium quality refrigerants

Why take chances on refrigerants that are supposed to be "just as good" when it doesn't cost you a penny more to buy "Freon"—the original, *time-tested* safe refrigerant? Insist on "Freon" *premium quality* refrigerants—factory-sealed by Du Pont in cylinders with the new gold hood cap—and enjoy their trouble-free performance in any type of equipment.

For complete information on applications, performance and properties of "Freon", write: *E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division, 1312, Wilmington 98, Del.*

SALES AGENTS: Ansul Chemical Co., Marinette, Wisconsin; and Virginia Smelting Co., West Norfolk, Virginia

FREON® *premium quality* **refrigerants**

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HELP US KEEP THE THINGS WORTH KEEPING

All is calm, all is bright. In America we are free to worship as we please, where we please. And we worship in peace.

But like so many precious things, peace doesn't come easy. Peace costs money.

Money for strength to keep the peace. Money for science and education to help make peace lasting. And money saved by individuals.

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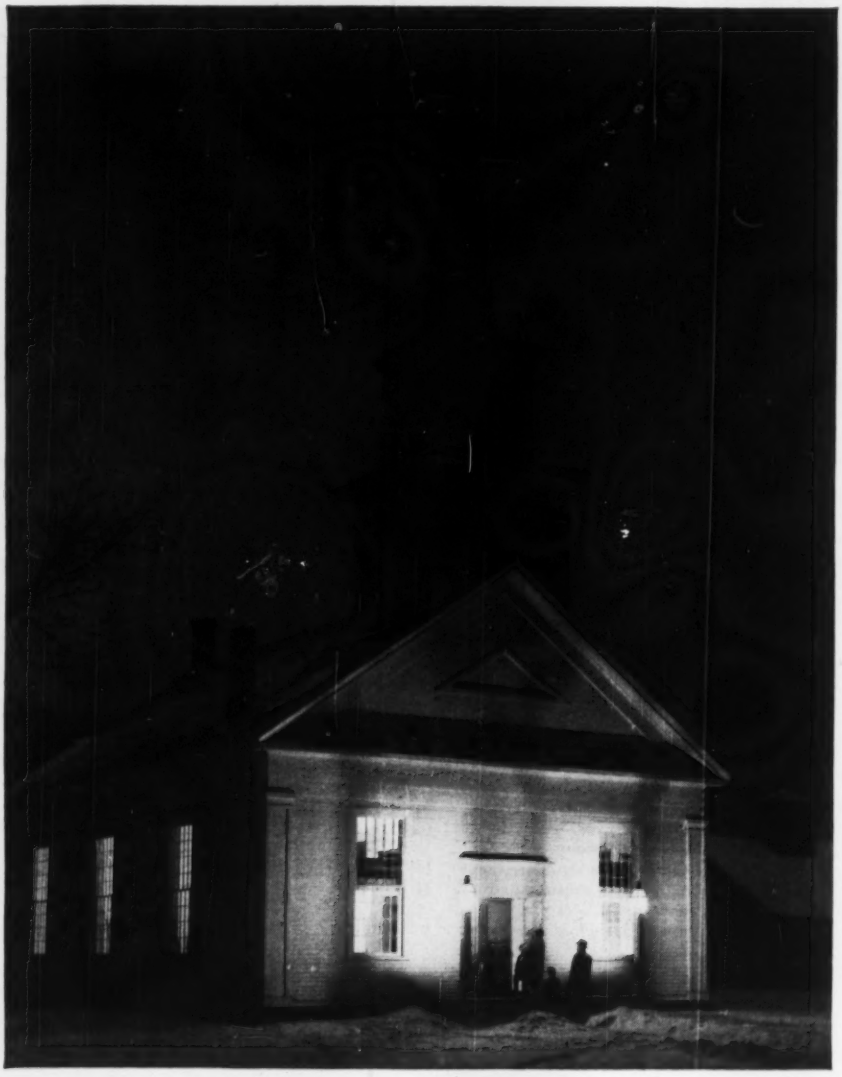

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If you want about	$2,500	$5,000	$10,000
each week, save	$4.75	$9.50	$18.75

This shows only a few examples. You can save any sum, buying Bonds by Payroll Savings or where you bank. Start your program now!

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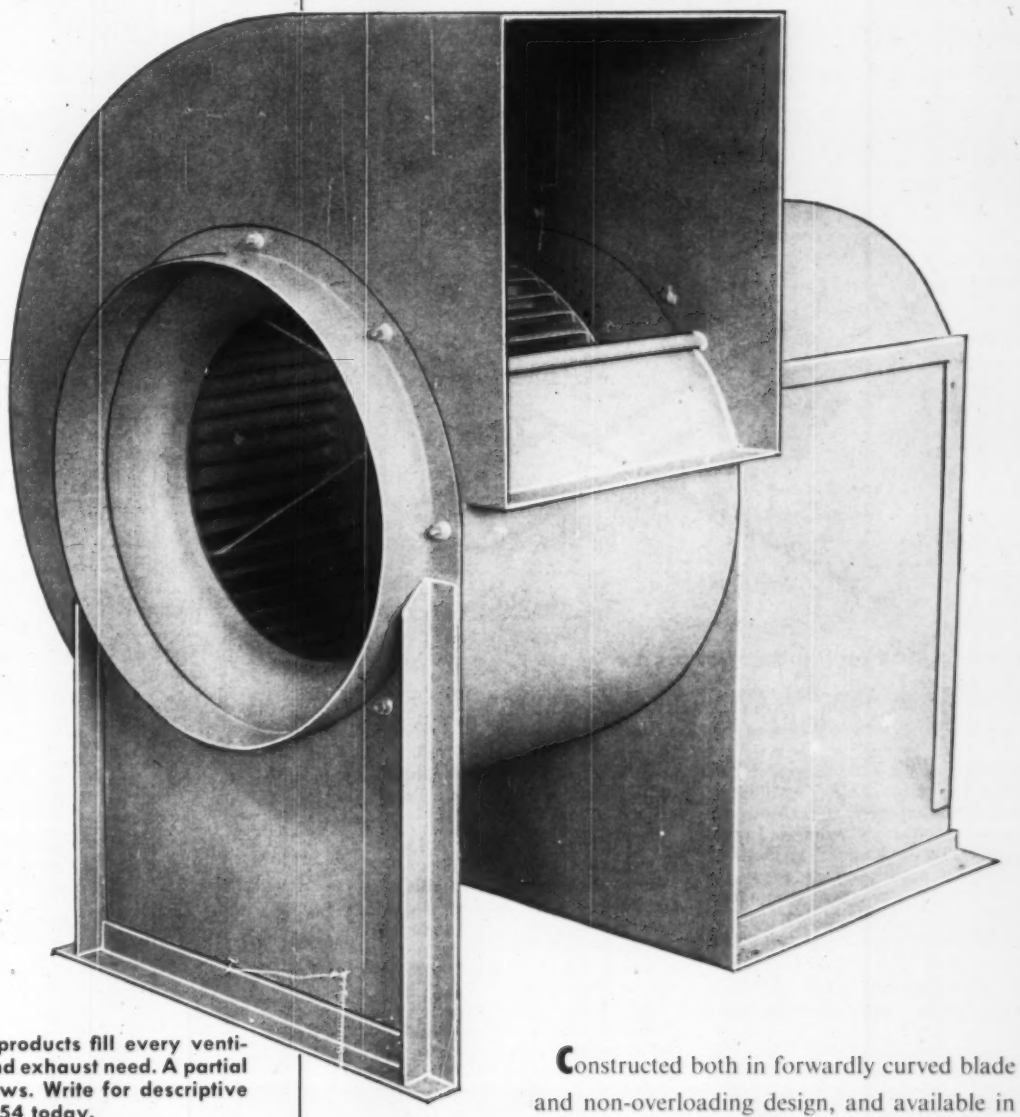
Belted Ventilating Sets do it BEST!



BARRY products fill every ventilation and exhaust need. A partial list follows. Write for descriptive bulletin 54 today.

- FC ventilating fans
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- Belted ventilating sets
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Constructed both in forwardly curved blade and non-overloading design, and available in 12 sizes to 22,000 cfm, Barry designed units perform your specific job easily and economically . . . Because they are convertible in discharge for ready adaptability, Barry belted ventilating sets get your installations into efficient operation in record time.

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JENKINS PRACTICAL PIPING LAYOUTS

82

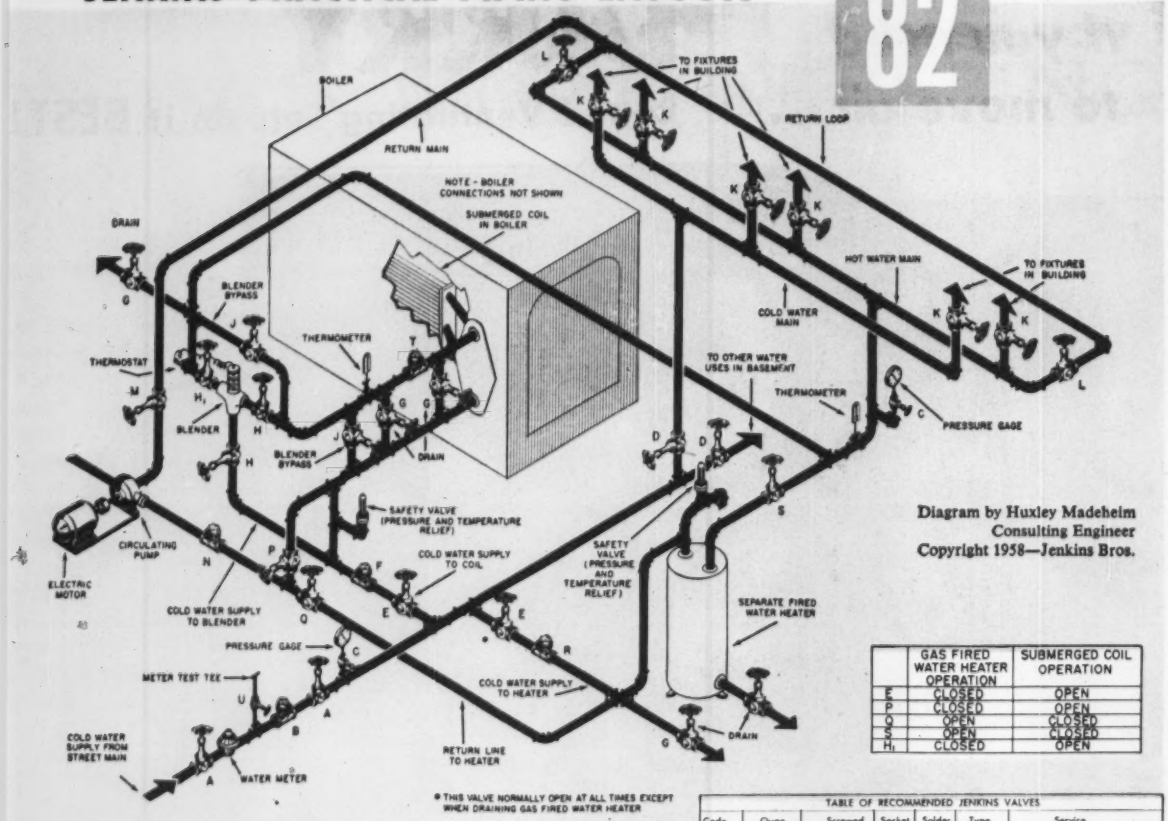

Diagram by Huxley Madeheim
Consulting Engineer
Copyright 1958—Jenkins Bros.

	GAS FIRED WATER HEATER OPERATION	SUBMERGED COIL OPERATION
E	CLOSED	OPEN
P	CLOSED	OPEN
Q	OPEN	CLOSED
S	OPEN	CLOSED
H_1	CLOSED	OPEN

* THIS VALVE NORMALLY OPEN AT ALL TIMES EXCEPT WHEN DRAINING GAS FIRED WATER HEATER

How to plan piping connections for

A HOT WATER SUPPLY SYSTEM

using both Submerged Coil and Separate Water Heater

Continuous hot water for general use is a requirement of many small office buildings, taxpayers, stores, and sections of multi-story buildings. In this layout, two conventional methods of supplying hot water are shown in combination, assuring continuous supply throughout the year with a minimum investment and maximum convenience.

A submerged coil utilizes as a heat source the main boiler whose primary function is to furnish heat for the building. A separately fired heater is employed to provide continuous hot water should the main boiler be shut down during the non-heating season or for maintenance. Connections to both units of hot water generating equipment are arranged so that change-over involves only the operation of valves. The distribution system shown incorporates a circulating pump and return loop, to guarantee hot water at the fixtures at all times.

A Blender valve with the submerged coil permits tempering water to desired temperature, and is equipped with bypasses to permit blender maintenance and emergency repairs without a shutdown. The separately fired heater has its own thermostatic control, so does not require a blender valve.

Safety valves protect both hot water generators. These valves are installed without shutoff to prevent damage and especially damage from possible steam generation in the separately fired heater. Also, it is recommended that cold water admission valve "E" to this heater be left open at all times, except when draining heater, to prevent formation of a vacuum or burning of heater if evaporated dry.

Bronze valves are used throughout because they give best service with most conditions of city water. All gate valves are of the traveling spindle type, which indicate position of wedge.

Jenkins Fig. 106-A screwed end bronze globe valve, (or its equivalent Fig. 1270 with socket ends, or Fig. 1270 with solder ends), is used extensively throughout this piping layout. Its renewable composition disc assures drop-tight closure, and it incorporates many other design and construction features which mean economical maintenance and long, trouble-free life.

TABLE OF RECOMMENDED JENKINS VALVES

Code	Quan.	Screwed	Socket	Solder	Type	Service
A	2	Fig. 47-U	1273	1242	Gate	Shutoff Cold Water Supply
B	1	Fig. 92-A	1272	1222	Check	Prevent Backflow to Main
C	2	Fig. 743-G			Needle	Control Pressure Gage
D	2	Fig. 47-U	1273	1242	Gate	Shutoff Cold Water Dist. System
E	2	Fig. 106-A	1270	1200	Globe	Control Cold Water Supply to Heaters
F	1	Fig. 92-A	1272	1222	Check	Prevent Backflow from Coil to Main
G	5	Fig. 106-A	1270	1200	Globe	Control Drains
H	3	Fig. 47-U	1273	1242	Gate	Shutoff Blender
J	2	Fig. 106-A	1270	1200	Globe	Control By-pass about Blender
K	6*	Fig. 106-A	1270	1200	Globe	Control Water Supply to Individual Fixtures
L	2	Fig. 106-A	1270	1200	Globe	Control Flow through Return Loop
M	1	Fig. 47-U	1273	1242	Gate	Shutoff Suction Circulating Pump
N	1	Fig. 92-A	1272	1222	Check	Prevent Backflow through Circulating Pump
P	1	Fig. 106-A	1270	1200	Globe	Control Flow Return Water to Coil
Q	1	Fig. 106-A	1270	1200	Globe	Control Flow Return Water to Heater
R	1	Fig. 92-A	1272	1222	Check	Prevent Backflow from Heater to Main
S	1	Fig. 47-U	1273	1242	Gate	Shutoff Hot Water Supply from Heater
T	1	Fig. 92-A	1272	1222	Check	Prevent Backflow through Coil
U	1	Fig. 106-A	1270	1200	Globe	Control Meter Test Line

*Dependent on quantity of fixtures.

To assure efficiency when planning a major piping installation, consult with accredited piping engineers and contractors, and select valves from the Jenkins Catalog.

FREE enlargement of this layout No. 82 sent on request to Jenkins Bros., 100 Park Ave., New York 17.

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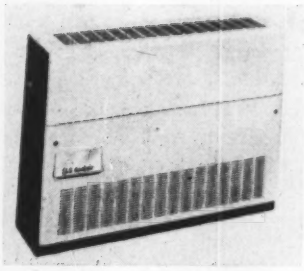
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864
Jenkins Bros.
Sold through Leading Distributors Everywhere

EQUIPMENT DEVELOPMENTS . . .

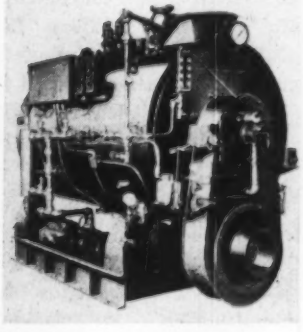
For reviews of Recent Trade Literature see page 204



Air Conditioning Units . . .

. . . intended for year 'round use with chilled and hot water—*Ilg Electric Ventilating Co., Dept. HPAC,* 2850 *N. Pulaski Rd., Chicago* 41.

"Dualair" cabinet-type air conditioning units offer volume range from 200 to 1400 cfm with cooling capacity of 1 to 5 tons, heating capacity 25 to 100 Mbh. Possible installation arrangements include: non-recessed, semi-recessed, fully recessed, universal and built-in for wall, floor, or ceiling mounting. Selection of discharge and intake locations provided. Can be operated by pneumatic, electric, electronic or manual controls. All models have large diameter, centrifugal fans operating at low tip speeds and outlet velocities for quiet operation. Fans coupled to resilient-mounted motors. Cabinet interiors lined with acoustical material.



Steam Generator . . .

. . . delivers 5000 lb of steam per hr —*Cyclotherm Div., National-U. S. Radiator Corp., Dept. HPAC,* 157 *E. First St., Oswego, N. Y.*

Marine-type steam generator delivers up to 150 hp. Floor area required for unit, 8 × 7 ft. Designed to government specifications, unit has oil pump set assembly furnished under unit. Water treatment tanks mounted on side of boiler shell, piped to feedwater pump system. Bypass piping permits manually controlled water circulation.

Pilot Burners . . .

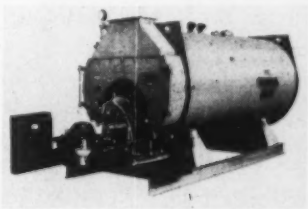
. . . in three new lines—*Eclipse Fuel Engineering Co., Dept. HPAC,* 1139 *Buchanan St., Rockford, Ill.*

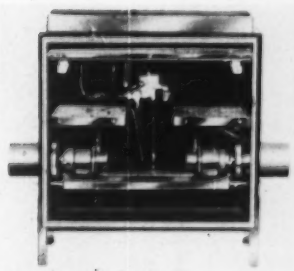
"Series EP" extended pilot burner, gas fired and internally spark ignited, used for igniting main gas, oil, or combination gas-oil burners too remotely placed for standard ignition. Available in lengths of 12, 18, 24, 36 and 48 in. Gas ignitor assemblies available with adjustable swivel ("Type SJ") or fixed position ("PRS") pilots for atmospheric and blast-fired applications. "DCP" draft compensating pilot supplies gas through standard injector carrying primary air for combustion. Pilot capacity is 20 to 70 cu ft per hr.

Boiler-Burner Units . . .

. . . in three new models ranging 59 to 464 hp—*Fitzgibbons Boiler Co., Inc., Dept. HPAC,* 101 *Park Ave., New York* 17.

"Model R" forced draft packaged boiler-burner units available in 13 sizes. Equipped with industrial type forced draft rotary oil burner, for all oils with or without preheaters, for oil and gas combinations and full gas firing. "Model PB" available in four sizes 59 to 93 hp. Equipped with low pressure atomizing burner for oils through No. 5. "Model P" forced draft packaged boiler-burner unit available in four sizes from 59 to 93 hp. Equipped with high pressure atomizing burner for light oils to No. 2, and gas or gas-oil combination. Units have full wet back, side combustion chamber construction.





Air Mixing Boxes . . .

. . . designed to provide precision control of air volume, temperature over wide range of varying inlet pressures without use of linkage, operating mechanism—*Air Devices Inc., Dept. HPAC,* 185 *Madison Ave., New York.*

"Con-Vol" mixing unit has flow regulators, standard pneumatic motors mounted on sliding base. System said to eliminate need of linkages and fulcrum points. Proportional control valve mounted directly on pneumatic motor shaft gives positive seal when valve is closed. On full cooling room thermostat holds hot valve closed. Flow regulator positions cold valve for desired design volume. Room thermostat also positions hot valve to give correct discharge air temperature.

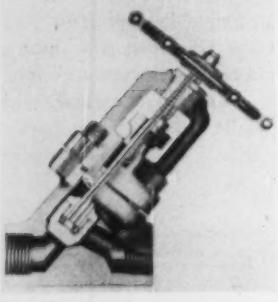
EQUIPMENT DEVELOPMENTS

Continued

Packaged Boiler . . .

. . . in sizes 500,000 to 20 million Btu per hr—*Orr & Sembower, Inc., Dept. HPAC, Box 1138, Reading, Pa.*

"Powermaster" has internal boiler water circulation permitting boiler to withstand three times its rated capacity in terms of thermal shock, says manufacturer. Advantages cited include: more protection against thermal shock; internal circulation path minimizes short circuiting; internal distribution system eliminates stratification; uniform internal temperature gradients.



Globe Valves . . .

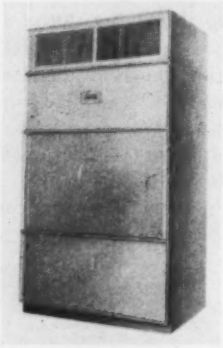
. . . with new design features—*Edward Valves, Inc., subs. of Rockwell Mfg. Co., Dept. HPAC, 1200 W. 145th St., East Chicago, Ind.*

Globe valves available in ¼, ⅜, ½, ¾ and 1 in. sizes with ratings of 600 psi at 910 F in carbon steel and 600 psi at 1030 F in chrome-molybdenum steel. Ambient rating at 100 F is 200 psi. Screwed end and welding end models are standard. New design features include: spiral-wound stainless-steel and asbestos gasket seals body-bonnet joint; disc made of chromium-cobalt-tungsten stainless steel alloy; seat made of stellite integrally welded to body.

Tank Drain . . .

. . . developed to eliminate need for manual draining of air compressors—*Squire-Cogswell Co., Dept. HPAC, 4151 N. Kedzie Ave., Chicago 18.*

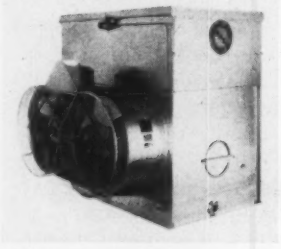
Electronic tank drain, 2⅜ × 2⅜ × 8¼ in., attached to or near air compressor, automatically purges water accumulation. Action said to prolong tank life, deter rust, eliminate odors, and prevent washing off lubricants. Bulletin available from company describes operation of unit.



Air Conditioners . . .

. . . for installation in areas open to public—*Typhoon Air Conditioning Co., Div. of Hupp Corp., Dept. HPAC, 505 Carroll St., Brooklyn 15.*

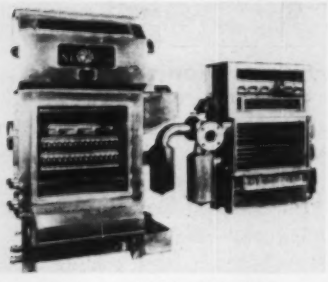
Water cooled, self contained air conditioners have expanded metal return air grille covering 8 sq ft of area in face of cabinet. Units 3, 5, and 8 tons measure 37 in. wide by 24½ in. deep and are 73½ in. high. Models with 10 and 15 ton capacities are 52 in. wide, 33 in. deep, 83 in. high. Cooling capacities are: 37,000 Btu per hr for 3 ton model; 60,600 Btu per hr for 5 ton model; 97,500 Btu per hr for 8 ton model; 125,000 Btu per hr for 10 ton model; 182,000 Btu per hr for 15 ton model. 15 ton unit available with single 15 hp compressor or two 7½ hp compressors.



Cooling Towers . . .

. . . in capacity range from 10 to 215 tons—*Baltimore Aircoil Co., Inc., Dept. HPAC, P. O. Box 7322, Baltimore 27.*

Capacity of each "Flexi-Tower" cooling tower can be adjusted over range with no mechanical change by changing spray pressure; only requirement is increase in pump size. Standard equipment includes pressure gage for accurate calibration of spray pressure, resultant capacities. Unit is factory assembled, blow through, propeller fan cooling tower with cooling tower design. Hot dipped galvanized steel used for protection against corrosion. Heavy, zinc-plated steel used in fan construction of wide blade, slow speed fans.



Compressed Air Chiller . . .

. . . designed for use in combination with aftercooler—*Niagara Blower Co., Dept. HPAC, 405 Lexington Ave., New York.*

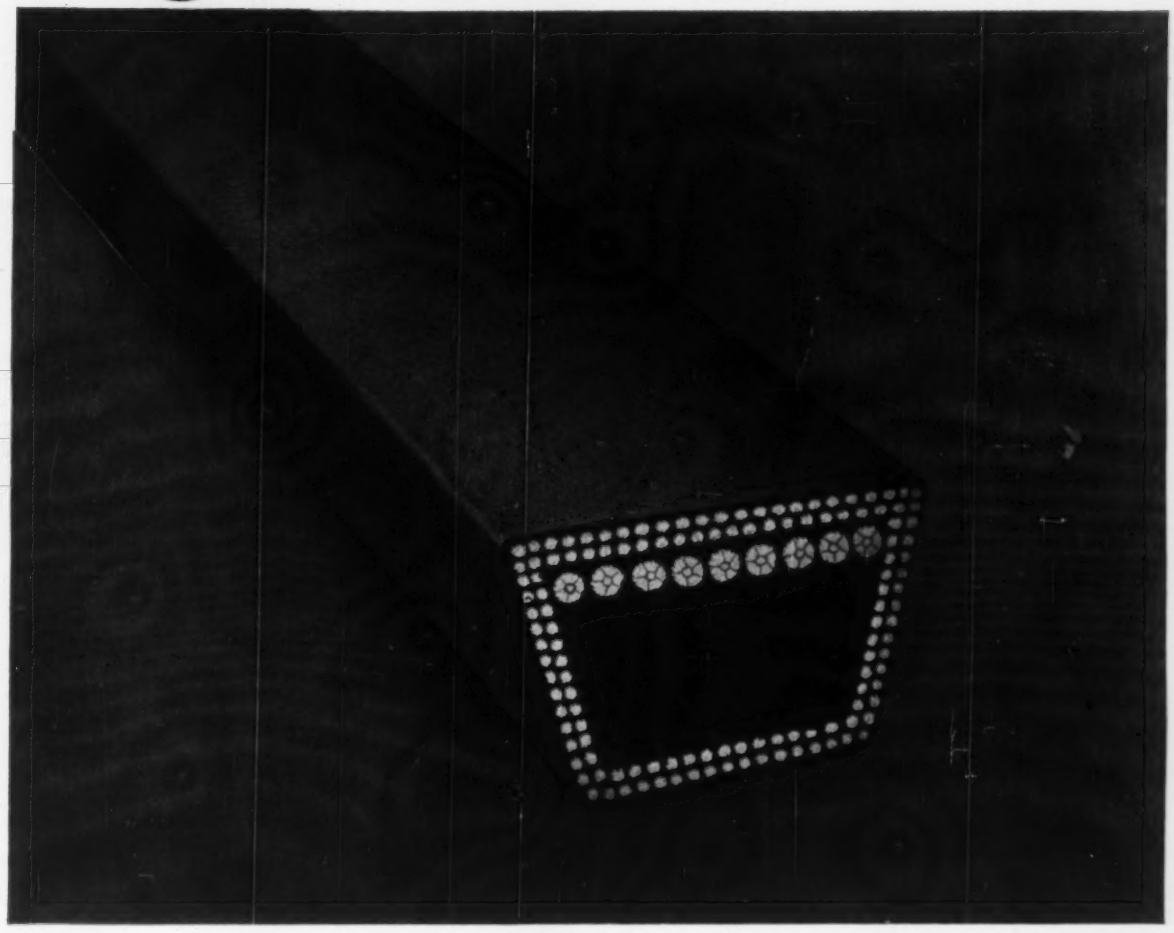
In first stage, aftercooler receives hot air from compressor, reduces to atmosphere temperature by evaporative cooling. Oil separator removes moisture, oil, dirt condensed from compressed air. In second stage, air chiller uses refrigeration to cool, dries air further. Recirculated water spray chilled by spraying over coils in which refrigerent is expanded. Chilled spray drenches compressed air coil reducing heat and moisture. Typical installation produces 45 F air at 90 psi pressure needing only 5 tons refrigeration for 900 cfm free air. Air moisture content is 0.065 lb per 1000 cu ft.

Air Filter . . .

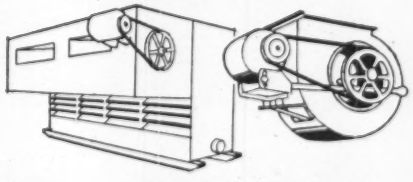
. . . in new "cut it yourself" design—*Research Products Corp., Dept. HPAC, 1015 E. Washington Ave., Madison 10, Wis.*

Aluminum media cut to size with scissors or knife. When filtering area is larger than 32 × 40 in. filter sheet, filters can be made by fastening two together with staples, hog-rings or aluminum glue.

US RUBBER V-BELTS



Quiet . . . smooth . . . vibration at the vanishing point



Unerring electronic controls; new methods of curing; the facilities of the largest and most modern plant devoted exclusively to the manufacture of endless transmission belts—these are the factors that bring to the heating and air-conditioning industry the one V-belt that erases vibration to the vanishing point.

The U. S. V-belt contributes greatly to the silent and efficient operation of fans, pumps, compressors, blowers—large or small—wherever power transmission is required for air-conditioning and refrigeration units.

• • •

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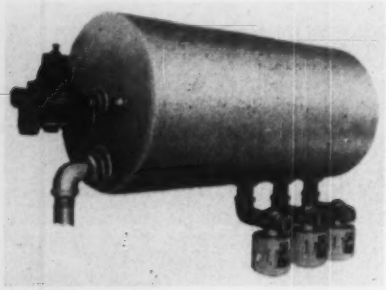
Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

EQUIPMENT DEVELOPMENTS

Continued



Zone Control Tank . . .

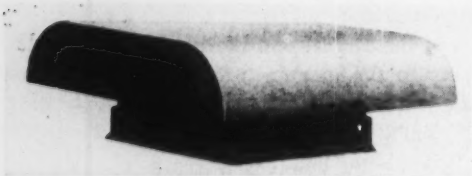
. . .developed to provide zone control for boilers—*Continental Mfg. Co., Dept. HPAC, P. O. Box* 4048, *Stansbury Rd. and B & O R.R., Baltimore* 22.

Installed with one to six control valves, zone control tank said to accomplish following functions: acts as expansion tank; collects entrained air from system water; tempers water to system on circulator start; eliminates temperature shock and air noise; provides zone control.

Three-phase Motors . . .

. . .designed to respond to current and temperature for protection against excessive overload currents, stalls, single-phasing, high ambient temperatures—*General Electric Co., Dept. HPAC, Schenectady* 5, *N. Y.*

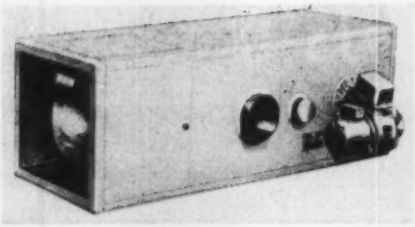
Motors intended for use with air conditioning compressors, centrifuges, other applications where severe-duty cycles encountered. Inherent protection device, located on motor frame and protected by pressed-steel cap, contains snap-acting thermal disc, three contacts and three heating elements in molded phenolic base. Connections made at neutral point of three-phase, Y-connected motor.



Gravity Roof Ventilators . . .

. . .designed to relieve pressure, provide efficient weatherproof ventilation over areas where positive exhaust exists—*E. Van Noorden Co., Dept. HPAC,* 122 *Magazine St., Boston* 19.

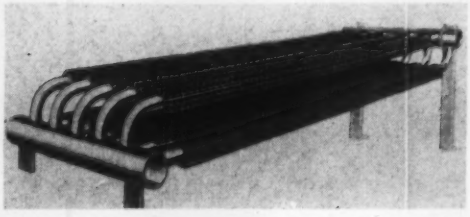
Low silhouette "Roof Line" ventilators have outlet opening 50 percent greater than inlet. Aluminum or copper units available in addition to standard units of galvanized sheet metal with angle iron framing. Choice of square and rectangular models available in 11 throat sizes from minimum of 12 in. on side to maximum of 60 in. Special sizes available. Dampers available with operating chain.



Oil-Fired Furnaces . . .

. . .designed to meet size, output requirements of commercial, industrial applications requiring various capacity units—*OverHead Heaters, Inc., Dept. HPAC,* 1612 *Book Bldg., Detroit* 26.

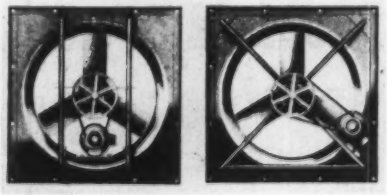
Oil-fired units available in models from 85,000 to 252,000 Btu per hr output, have stainless steel combustion chambers. Can be adapted in field for burner installation on either side.



Tank Heaters . . .

. . .incorporating horizontal or platform design for installation in floating roof tanks—*Brown Fintube Co., Dept. HPAC, Elyria, Ohio.*

"Model FR-11" tank heater has flat design to operate in clearance allowable when floating roofs are in lowest position. Maximum height is 15 in. from tank bottom. Mounted on short, rigid legs to allow minimum clearance of tank bottom of 2 in. Furnished in mild steel, chrome alloy or nickel. Pipe ends normally bevelled, but flanged or other types of connections furnished when specified. Each unit has pressure rating of 600 psi at 600 F based on 1/16 in. corrosion allowance.



Propeller Fans . . .

. . .developed for industrial and commercial ventilation —*American-Standard, American Blower Div., Dept. HPAC, Detroit* 32.

"Model IC Ventura" propeller fans available in 42 low pressure models with ratings to 75,330 cfm at zero static pressure or 71,740 cfm at 1/8 in. WG. High pressure fans available in 50 different models with ratings to 81,000 cfm at zero WG or 44,800 cfm at 1 in. WG.

"I cut welding time when

B&W Welding Fittings

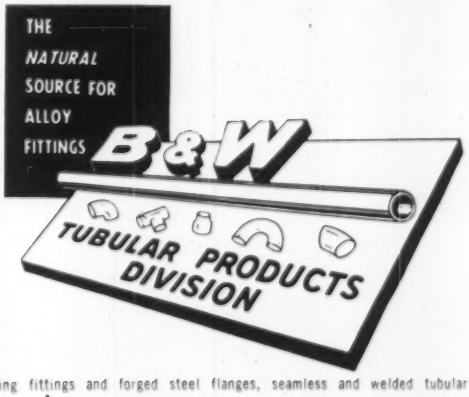
are specified!"

"From my own experience, I know that B&W Welding Fittings are dimensionally accurate and fit-up fast and positive. Welding time is reduced and one can make a trouble-free permanent joint. That means lower piping costs."

THE dimensional accuracy of B&W Welding Fittings makes a welder's job easier and helps to make his work more precise. Trouble caused by poor fit-up to pipe is eliminated. Every fitting has true circularity, full radius and walls of uniform thickness, which result in time saved in installation, top-quality joints, and helps to achieve a permanent, leak-proof, piping system. Write for bulletin FB504.

B&W Welding Fittings and Forged Steel Flanges are available in a complete range of types and sizes in carbon steel and the B&W CROLOYS.

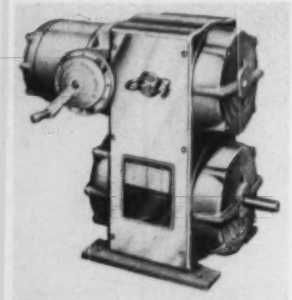
THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION • FITTINGS DEPARTMENT
3839 WEST BURNHAM STREET • MILWAUKEE 46, WISCONSIN



FA-8903 FEI

Seamless welding fittings and forged steel flanges, seamless and welded tubular products, solid extrusions — in carbon, alloy, stainless steels and special metals.

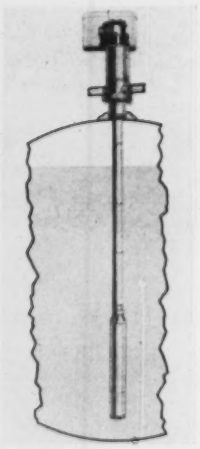
EQUIPMENT DEVELOPMENTS
Continued



Adjustable Speed Drive . .

. . .designed to provide infinitely adjustable speed over ranges of 8:1—*Louis Allis Co., Dept. HPAC, 427 E. Stewart St., Milwaukee* 1.

"Allispede" adjustable speed drive operates from a-c power source. Available in ratings 1 to 20 hp with output speeds 1 to 10,000 rpm. For applications in food and chemical processing, other pumping and piping applications. Units may be mounted vertically or horizontally on floor, wall or ceiling with output shaft and motor in any of four positions. Constant speed, squirrel cage induction motor provides adjustable speed through mechanical interaction of adjustable diam discs and ribbed belt.



Submersible Pumps . . .

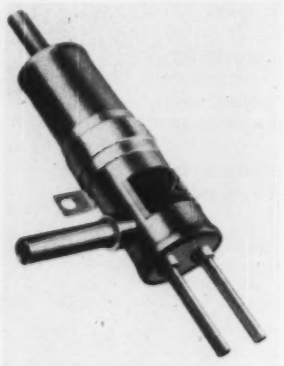
. . .available with 1, 1½, 2, 3, 5 hp motors—*Red Jacket Mfg. Co., Petroleum Equipment Div., Dept. HPAC, P. O. Box* 270, *Davenport, Iowa.*

"Big-Flo" pumps designed for use in underground storage tanks in bulk plants, etc., and will handle gasoline, fuel oil, diesel oil, kerosene. Units will fit tank openings through 6 in., may be lifted from tank without disconnecting pipe. Motor features: windings hermetically sealed in stainless steel; plug-in connection between motor and lead wires; stainless steel shaft; overload protection device.

Draft Control . . .

. . .designed for small boiler installations—*Simplex Mfg. Co., Dept. HPAC, 198-206 Main St., Fon du Lac, Wis.*

"Type H-HG" automatic draft control in sizes 6 to 24 in., available as combination control for coal-oil-gas fired plants. Unit said to provide full control of draft intensity and 100 percent back pressure relief. May be installed on side of under breeching.



Heat Transfer Coil . . .

. . .designed to permit handling of fluids, vapors, corrosive gases—*Young Radiator Co., Dept. HPAC, 709 S. Marquette, Racine, Wis.*

Coil said to reduce temperatures from 600 to 100 F at working pressures to 2500 psi. Constructed of No. 316 stainless steel. For testing in chemical processing plants, paper mills, boiler systems, laboratories, etc.

Spray Nozzle Mounting . .

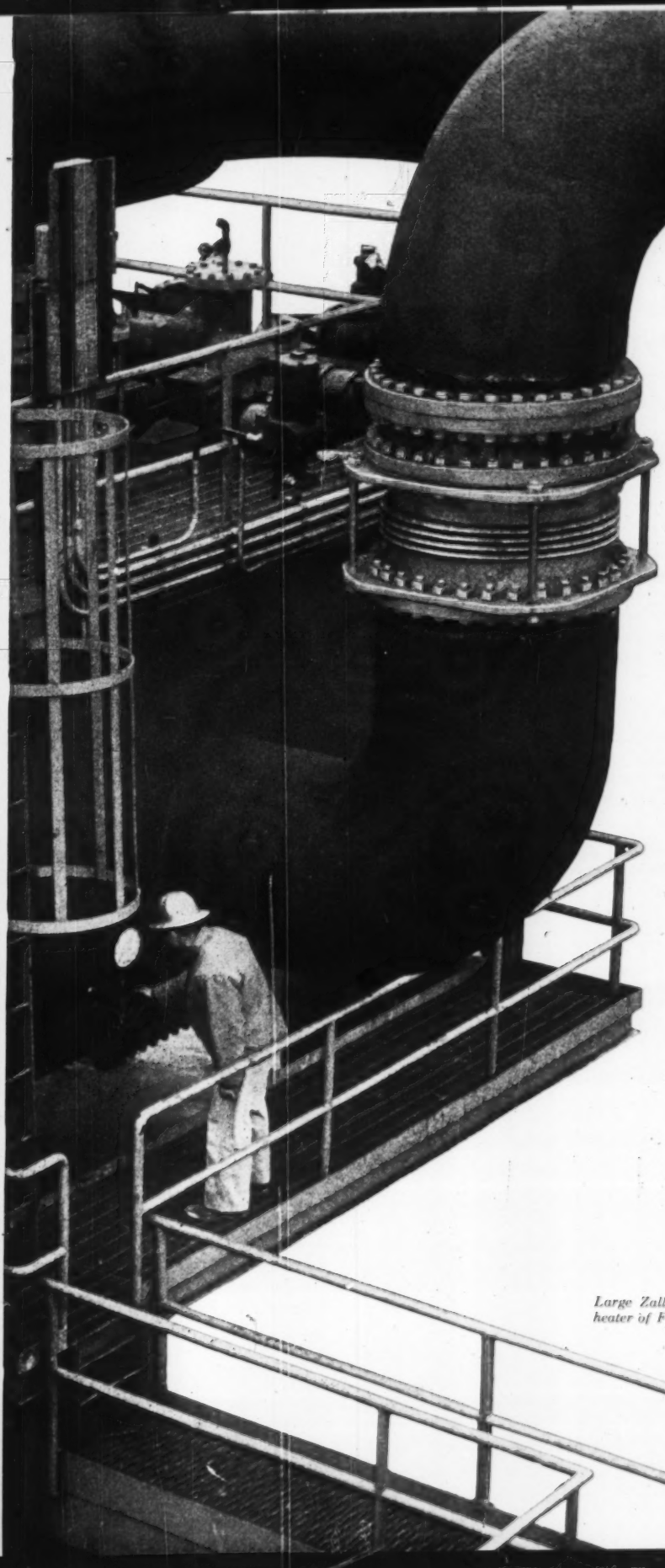
. . .designed for liquid, gas, air lines for pressures to 250 psi—*Spraying Systems Co., Dept. HPAC,* 3219 *Randolph St., Bellwood, Ill.*

"Split-Eyelet Connectors" provided in clamp sizes to fit ½, ¾, and 1 in. pipe and 13/16, ⅞, 1, 1-1/16, 1¼ and 1⅜ in. OD tubing for use with ⅛ and ¼ in. spray nozzles of all types. Gages or hose may be mounted to lines with connectors. Design features include: twin bolt clamp compression; heavy duty clamp in cadmium plated steel or stainless steel; body materials in brass or stainless steel; hexagon body shape intended to prevent turning of body when nozzles or fittings tightened.

Illuminated Indicator . . .

. . .developed to directly measure, indicate, transmit pressure, draft, differential, and fluid level—*Bailey Meter Co., Dept. HPAC,* 1050 *Ivanhoe Rd., Cleveland* 10.

As direct connected gage, each of two indicators may contain diaphragm element for draft, low pressure, or differential measurement; bellows element for intermediate pressure or level measurement. Ranges 0.5 in. water gage to zero to 5000 psig available. Seven in. indicating scales available in red, green, blue, yellow, orange, white.



Get positive piping protection with

ZALLEA NON-EQUALIZING EXPANSION JOINTS . . .

Zallea Non-Equalizing Corrugated Expansion Joints offer a degree of protection that can't be equalled for absorbing movement of piping due to temperature changes. They protect interconnected equipment by absorbing movements in otherwise rigid piping systems. They are used in low pressure and vacuum lines . . . between stills, tanks, columns, condensers, pumps and similar equipment.

Standard Sizes: 3″ to 72″ dia.; Special sizes to 50 ft. dia. Pressures: Vacuum to 50 psig Temperatures: to 1600°F.

Special Applications. With the addition of proper components, Zallea Non-Equalizing Expansion Joints can be used as:

Universal Expansion Joints to absorb movement in any direction . . . axially, laterally, angularly, or any combination of these.

Pressure Balanced Expansion Joints to absorb axial movement outside the unit and still carry pressure thrust.

Hinged and Gimbal Expansion Joints for piping systems that cannot be anchored in the conventional manner.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. They are available for any pressure condition to 3600 psig. Write, on your company letterhead, for your copy of Catalog 56.

Zallea
expansion joints

Zallea Brothers • Wilmington 99, Delaware

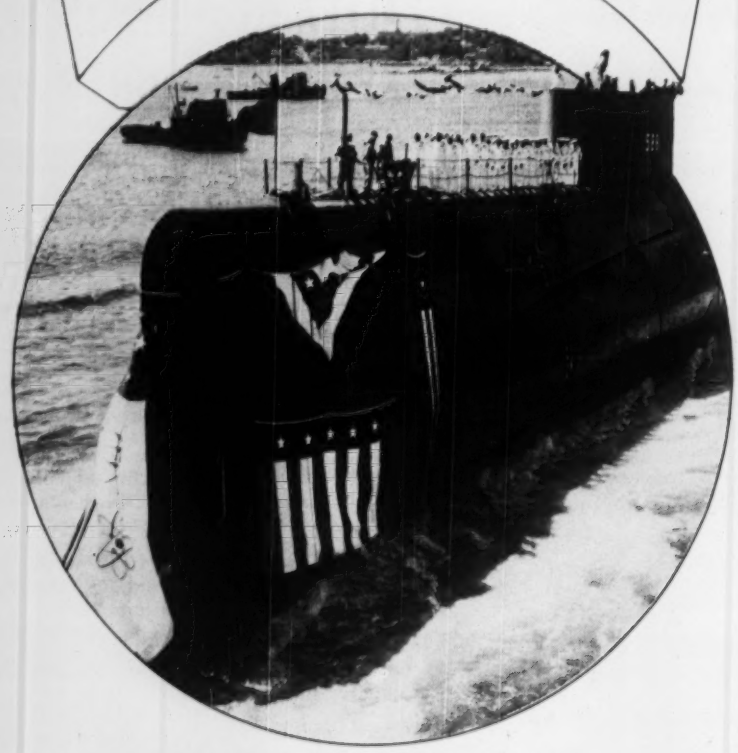
World's largest manufacturers of expansion joints

Large Zallea Non-Equalizing Expansion Joint installed on deaerating heater of Ford Motor Company's River Rouge plant.

BONNEY WELDOLETS

for the world's biggest

ATOMIC SUBMARINE



TRITON* Main Steam** *Line Branch Connections* ***full size *and* ***reducing*** *sizes made with Bonney Weldolet Fittings.*

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ELBOLETS®
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CARBON STEEL
STAINLESS
ALLOY
for all services

Bonney Weldolets featuring strength, improved flow conditions and easy, economical installation are used on the atomic-powered TRITON, world's largest and most powerful submarine. Launched in August, 1958 at the Groton, Connecticut shipyard of General Dynamic's Electric Boat Division, this twin-reactored sub—447 ft. long and displacing 5,900 tons—is scheduled for radar picket duty.

For detailed information about all Bonney Welding Fittings, call or write today!

BONNEY FORGE AND TOOL WORKS

ALLENTOWN, PENNSYLVANIA

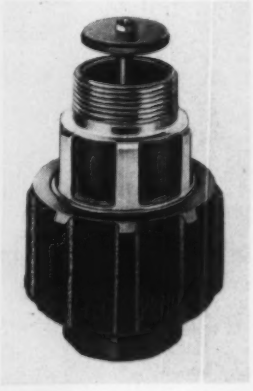
EQUIPMENT DEVELOPMENTS

Continued

Hot Water Generator . . .

. . . designed for heating, snow melting, temperature control, hot water supply — *Precision Parts Corp., Dept. HPAC, 400 N. First St., Nashville 7, Tenn.*

Factory-assembled unit includes generating tubes, thermostats, water circulator, and safety valve. Designed for panel, convector, baseboard, radiator-type heating systems. Unit can also be used in combination with water chiller for year 'round air conditioning.

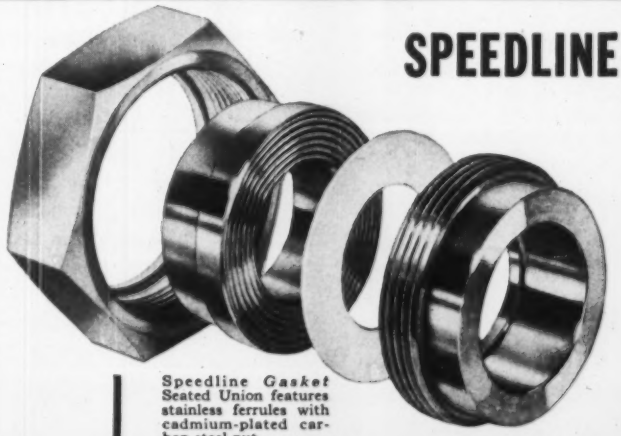


Check Valve . . .

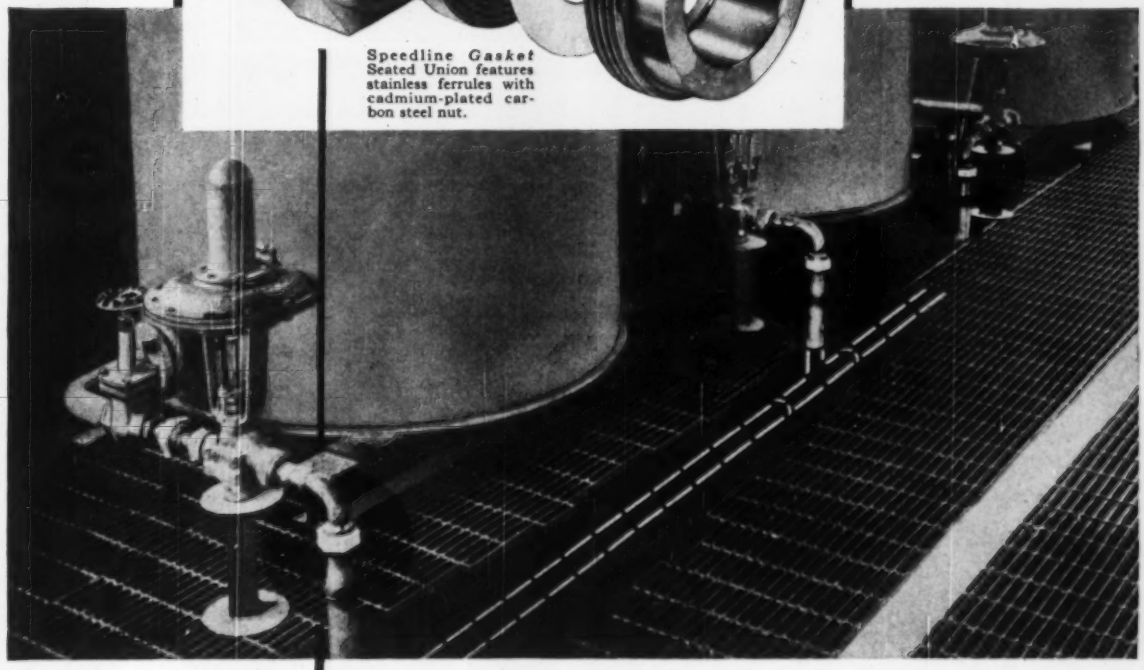
. . . designed for installation without cutting pipe on existing installations —*Universal Valve Co., Inc., Dept. HPAC, 611 South St., Elizabeth, N. J.*

Full-flow "205-ORU" 1½ in. pump check valve composed of four basic parts: valve body, spacer, threaded nut, female-threaded shank. Body screwed directly into pump casing; female-threaded shank attached to incoming pipe; spacer inserted between body and shank, placing nut in alignment to be tightened. Valves furnished with either composition discs or metal-to-metal valve seats.

SPEEDLINE FITTINGS SOLVE LEAKAGE AND ASSEMBLY PROBLEMS



Speedline *Gasket* Seated Union features stainless ferrules with cadmium-plated carbon steel nut.



Here's the stainless steel union to eliminate troublesome ground joints. The Speedline Union is ***gasket seated*** to eliminate leakage . . . ***bi-metallic*** to permit easy disassembly and make-up *without* galling or seizing. It's available in two styles . . . for welding or expanding to low cost Schedules 5 and 10 pipe and the complete line of Speedline fittings.

Advantages of Speedline Unions simplified piping problems at American Alcolac's Baltimore plant . . . permits ready removal of process lines located beneath floor grating when necessary. Use of Speedline Fittings throughout the plant's piping system reduced labor and materials costs to a minimum . . . maintained high degree of process purity demanded in process operations.

The *complete line* of Speedline Fittings with the exclusive "extra length" feature, offer many assembly advantages and cost savings not possible with conventional fittings. Request your copy of Speedline Catalog today.

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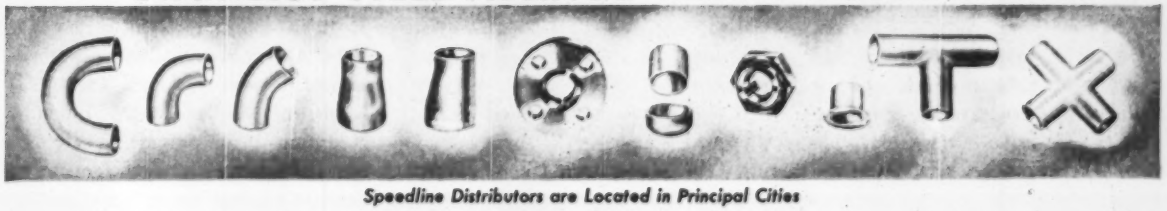
Speedline®

SPEEDLINE IS A REG.T.M. OF HORACE T. POTTS COMPANY

STAINLESS STEEL FITTINGS—FOR THE ULTIMATE IN PROCESS PIPING EFFICIENCY



Speedline Distributors are Located in Principal Cities

Manufactured by **HORACE T. POTTS COMPANY** • 502 E. Erie Avenue • Philadelphia 34, Penna.

EQUIPMENT DEVELOPMENTS
Continued

Polyethylene Pipe . . .

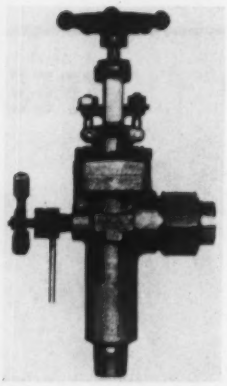
. . .developed to eliminate stress cracking—*Carlon Products Corp., Dept., HPAC,* 10225 *Meech Ave., Cleveland* 5.

"Hi-Mol" pipe made from virgin polyethylene of unique molecular structure, says manufacturer. Slits, pinholes said to be prevented by molecular structure. Resistant to chemical corrosion, abrasion, deterioration from sunlight and subzero temperatures. Available in sizes ½ through 2 in. in schedule 40 IPS and 75 psi pressure rated. Additional sizes available for industrial applications. Continuous lengths of 3 to 6 in. pipe available in units to 500 lb total weight. Can be used with most chemicals with operating temperatures as high as 150 F.

Gage Protector . . .

. . .developed to offer positive protection for instruments such as manometers, draft gages, electrical pressure switches, ultra-sensitive low-pressure transducers—*Industrial Engineering Corp., Dept. HPAC,* 525 *E. Woodbine, Louisville, Ky.*

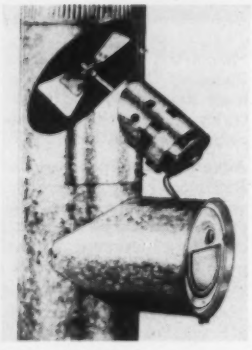
Designed for atmospheric or relative pressure system applications, "Gage Gard Jr." is repeatable and will reopen after sealing at 2 percent below cutoff point. Adjustment and resetting of pressure point can be made at any time, says manufacturer. Available in four ranges, covering span of −15 to 85 psig. Specifications, parts lists given in company's bulletin "457 G."



Bleed-off Valve . . .

. . .in new addition to company's line—*Manning, Maxwell & Moore, Inc., Dept. HPAC,* 250 *E. Main St., Stratford, Conn.*

"Type 5560-S" stop and bleed-off valve is of angle-type with a ¾ in. male NPT inlet, ¼ in. female NPT union outlet and a ¼ in. NPT bleed-off valve connection. Ratings are 600 psi at 910 F and 2000 psi at 100 F. Outside screw, yoke, body come in choice of forged carbon steel, Type 304 stainless steel, Type 316 stainless steel. Trim material is standard 11 to 13 percent chrome stainless steel, but 304 or 316 stainless steel also available. Bonnet gasket made of spiral wound stainless steel and asbestos.



Draft Inducer . . .

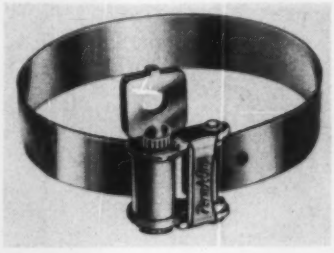
. . .developed for oil, coal, gas-fired installations—*Walker Mfg. and Sales Corp., Dept. HPAC,* 1720 *Penn St., St. Joseph, Mo.*

"Shur-Flo" draft inducer consists of motor driven fan mounted on flue pipe with stainless steel shaft extending inside pipe carrying stainless steel propeller type fan blade. Unit operates on 0.5 amp at 110 volts a-c.

Pressure-Vacuum Control

. . .designed for use in hazardous locations where explosive gases or vapors are present—*United Electric Controls Co., Dept. HPAC,* 79 *School St., Watertown* 72, *Mass.*

"Type J95" is uncalibrated; pressure settings made by internal adjusting nut. Models available with ranges between zero and 500 psi and maximum pressures to 600 psi. Switch types include: normally open; normally closed; double throw with no neutral position. Ratings at 15 amp and 115 or 230 volts a-c, other ratings also available. All switches single pole, suitable for 180 F ambient temperature.



Tube Clamp . . .

. . .in design incorporating pawl-and-ratchet locking principle—*Dixon Valve & Coupling Co., Dept. HPAC,* 134 *Columbia Ave., Philadelphia* 22.

"Perm-A-Grip" reusable clamp attached, tightened by winding action; clamping band reeled in, leaving no excess exposed. Three standard sizes for outside diameters from ¾ to 8 in. Band is stainless steel; other parts, heat treated steel, cadmium plated. For applications with all types of hose, tubing and flexible pipe connections, insulating covers and pads on heating lines.

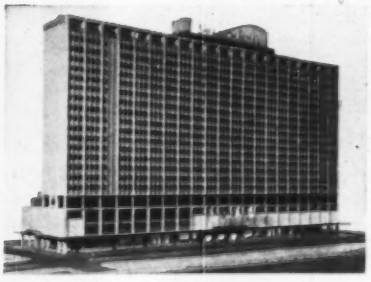
Heat Exchanger Tube . . .

. . .in new line—*Chase Brass & Copper Co., Dept. HPAC,* 236 *Grand St., Waterbury* 20, *Conn.*

Available in straight lengths to 75 ft, in diameters from ⅝ to 1 in. Tube also produced with uniform gage U-bends, thickened center U-bends, or thickened end U-bends, according to requirements. Recommended by manufacturer for use in chemical, petrochemical and power industry applications.

B.F.Goodrich

B. F. Goodrich saves Sheraton a cool $9,517.26



Philadelphia's new Sheraton boasts 8,100 feet of B. F. Goodrich Cell-Tite Tubing on water lines of 1,000 room air conditioners, and for good reason!

Saves labor costs: "With B. F. Goodrich Cell-Tite Tubing," says Mr. Earle Baltz, executive of Achenbach & Butler, Inc. insulation specialists, "we cut the time needed to put insulation on two lengths of pipe from a normal three hours to only 20 minutes. This individual saving of two hours and forty minutes became a saving of 2,666 man-hours on the whole job. Labor on this cost $3.57 per hour—multiplied by the total time, making a saving of $9,517.26!"

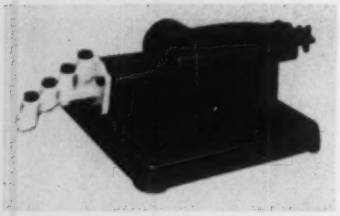
Why they selected B. F. Goodrich Cell-Tite: "It effectively prevents condensation on pipes carrying cold water through warm areas, holds heat of hot water in pipes. The material suffers no effects from constant exposure to maximum heat rating . . . continually holds up under heats approaching its rated 220° resistance, has a K factor of 27 giving maximum insulation without undue thickness, is consistent and uniform in quality and assures even all-around insulation by being of 'closed-cell' construction."

Easy to install: "This tubing cuts labor costs by easy-threading on pipe, fits around bends, gives a much neater appearance. To strip the ends, we held the tubing back clear of the connection, held it in place with wire. After the connection was made, the wire was cut and the insulation moved over the exposed section. Even after being wired in a compressed position for two months, the tubing showed no permanent set!"

Get free booklet: For complete information and free booklet write The B. F. Goodrich Company, 481 Derby Place, Shelton, Connecticut.

B.F.Goodrich
insulation tubing

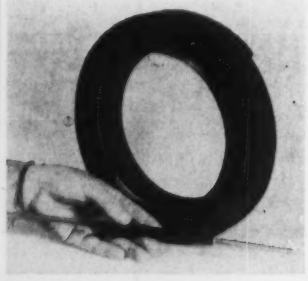
EQUIPMENT DEVELOPMENTS
Continued



Controlled Volume Pumps

. . . with minimum of working parts and bearing surfaces to translate high speed rotary motion to low speed reciprocating motion—*Milton Roy Co., Dept. HPAC,* 1300 *E. Mermaid Lane, Philadelphia* 18.

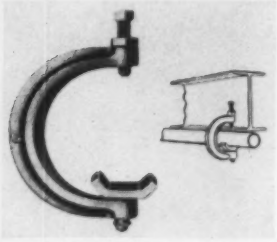
"Polar-Crank" drive unit and speed reducer is integral part of pumps and runs in oil bath, permitting manual or automatic adjustment of capacity from zero to 100 percent. Capacity adjustment closely approximates linear relationship and can be made while pump is running. Using standard speed motors, several volume pumps can be coupled to single motor with each pump retaining individual capacity adjustment. With liquid ends constructed of alloy steels for corrosion resistance, pumps have capacities to 29 gph and will meter against pressures to 1900 psi.



Finned Tubes . . .

. . . in new 6 in. OD size—*Griscom-Russell Co., Dept. HPAC, Massillon, Ohio.*

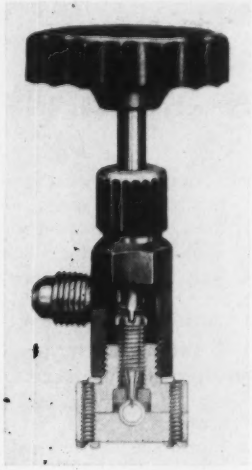
Fins increase heat transfer surface to 10 times bare tube area. Range in height ¾ to 1¼ in. for new 6 in. size. Available to withstand pressures to 5000 psi and temperatures to 1150 F, depending on materials. Fin and tube materials include steel, copper, aluminum, admiralty, monel, stainless steels, and chrome molybdenum steels. Precoiled fins wound under tension into grooves on tube. Helical finned tubes used in heat exchangers for air and gas inter- or after- cooling, pipeline heating, fuel preheaters, chemical vapor condensing, exhaust steam condensing, heating or cooling air, other liquids.



"G" Clamp . . .

. . . with pipe or conduit saddle added to lower jaw—*Grinnell Co., Inc., Dept. HPAC,* 260 *W. Exchange St., Providence* 1, *R. I.*

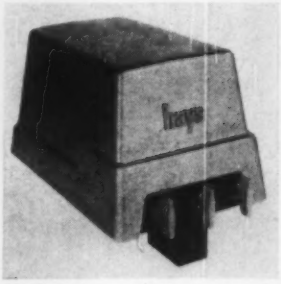
Developed from "C" clamp, malleable iron "G" clamps are for variety of applications where conduit and pipe to 4 in. must be supported directly under structural steel. Maximum recommended loads from 210 to 450 lb, for the smallest to largest sizes, and temperatures to 450 F, with safety factor of 5.



Tube Piercing Valves . . .

. . . in new, complete line—*Henry Valve Co., Dept. HPAC,* 3215 *North Ave., Melrose Park, Ill.*

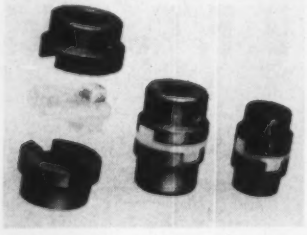
Line includes tap, port, and control valves. Line tap and line port valves provide permanent capped port for charging, discharging, testing. Line port valves primarily for sealed systems. Control valves, angle, and two-way types, designed for use with company's auxiliary valves. All valves in line are corrosion resistant, tamperproof, will withstand vibration and have leakproof seals.



Flow Transmitter . . .

. . . developed for measuring flow, liquid level, other variables which are functions of differential pressure—*Hays Corp., Dept. HPAC,* 800 *E. Eighth St., Michigan City* 14, *Ind.*

"Model 245" is frictionless, liquid-free flow transmitter with no torque tubes, stuffing boxes, knife edges, or bearings. Transmitter is bellows-actuated type. Only sensing element is single element bellows. For pipe mounting, unit can be mounted on convenient vertical section of 2 in. pipe. Available in ranges from 20 to 600 in. water gage.



Flexible Coupling . . .

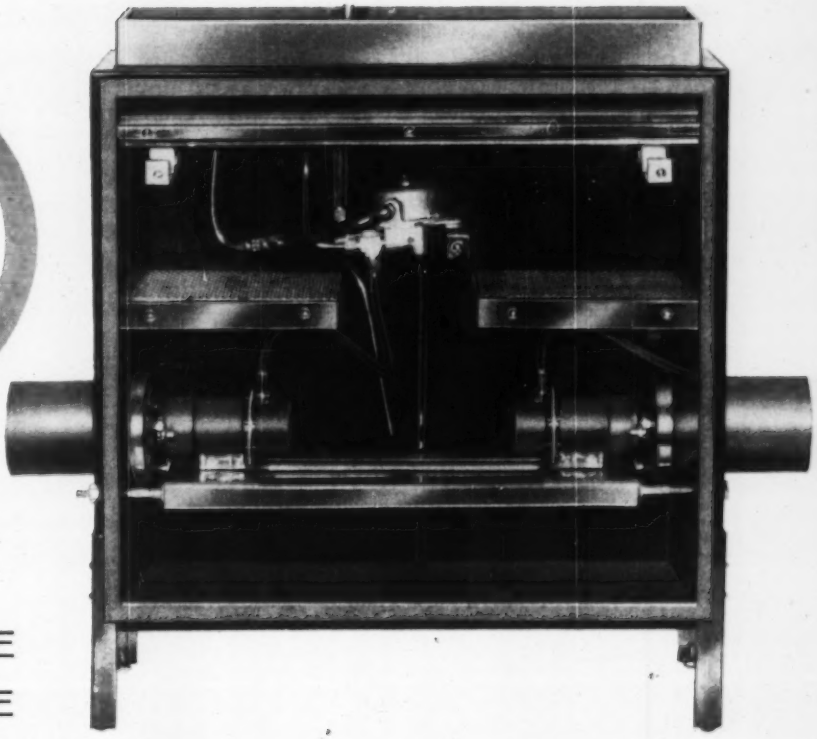
. . . with floating nylon center member—*Climax Metal Products Co., Dept. HPAC,* 863 *E.* 140*th St., Cleveland* 10.

Double-engagement flexible coupling for fractional horsepower applications employs replaceable molded nylon disc to absorb shock and misalignment. Couplings are of miniature size: overall dimension of largest is 1½ in. long by 1¼ in. diam. Initially produced in ratings of ⅛, ¼, and ½ hp at 1750 rpm. Torque

NEW

CON-VOL EQUIPPED HIGH VELOCITY UNITS

CONSTANT VOLUME UNDER ALL CONDITIONS



EXCLUSIVE FEATURE ASSURES PRECISION CONTROL OF AIR VOLUME AND TEMPERATURE

The new Thermotank Con-Vol Unit delivers constant air volume over a wide range of varying inlet pressures. Instant response and positive valve closure are obtained due to the complete absence of linkage or complicated operating mechanism. Both the hot and the cold valves are regulated by the flow controller as conditions demand. An access door permits inspection of all moving parts and easy removal of valves and controls. For more information on Con-Vol equipped units ask your Thermotank-Agitair representative or write direct to Air Devices Inc.

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THE TITUSVILLE 3-PASS BOILER-BURNER UNIT

This is the modern 3-PASS boiler with *complete* wet back that makes refractory problems a thing of the past . . . the Titusville Boiler that gives you faster steaming, better heat extraction, higher efficiencies all along the line! No welded tubes, lower stack temperature—everything for longer life and dependable service. *Check us!*

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Plants at Titusville, Pa. and Warren, Pa.
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EQUIPMENT DEVELOPMENTS

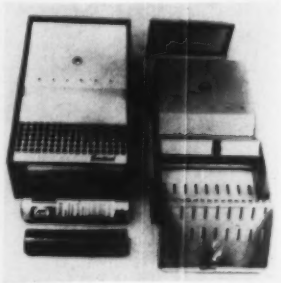
Continued

loads are transmitted through free-floating nylon member for resistance to shock, maximum compensation for vibration and angular and parallel shaft misalignment.

Vise Stands . . .

. . . in combination with vise—*Toledo Pipe Threading Co., Dept. HPAC, 1445 Summit St., Toledo 4, Ohio.*

New vise stands in two new models: "7C" with chain vise, ⅛ to 5 in. and "7Y" with yoke vise, ⅛ to 2½ in. Either model can be converted from chain to yoke or yoke to chain with few additional parts. Bases have three pipe benders over rear leg, said to eliminate tipping when bending pipe.



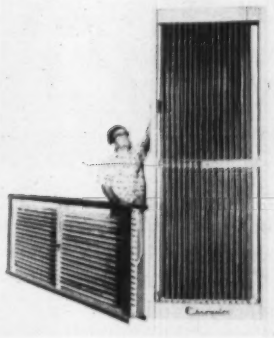
Odor Control . . .

. . . employing company's solid form odor counteractant—*Airkem, Inc., Dept. HPAC, 241 E. 44th St., New York 17.*

"Sentinel" dispensing unit for packaged air conditioner units consists of two sections. Inner unit made of anodized aluminum, measures 15-¾ × 9-1/3 × 4½ in.; outer cover is 16½ × 9-⅜ × 5½ in. Unit fastened to packaged air conditioner so vapors

EQUIPMENT DEVELOPMENTS
Continued

from evaporation chamber are drawn into air conditioning air stream. Design permits gradual feeding of fresh solid odor counteractant into chamber as charge is exhausted.



Electric Heating Bank . . .

. . . intended for use with auditorium type unit ventilators—*Edwin L. Wiegand Co., Dept. HPAC, 7500 Thomas Blvd., Pittsburgh 8.*

Heating elements are tubular finned metal sheath type. Fintube elements have totally enclosed, insulated construction. Units shown have 128 kw capacity, may be mounted in series for greater capacity.

Flexible Hose . . .

. . . developed to give extreme flexibility, high resistance to deterioration—*Burton Mfg. Co., Dept. HPAC, Middlefield, Ohio.*

Hose extruded in continuous, seamless lengths of neoprene. Has spiral-ribbed construction, permitting hose to retain circular cross section even when bent sharply. Can be crushed without damage. Use of neoprene elastomer provides resistance to oxidation, oxone, oils, dilute acids, sunlight and heat aging and abrasion. Produced in 2, 2½ and 3 in. diam in lengths to 11 ft.

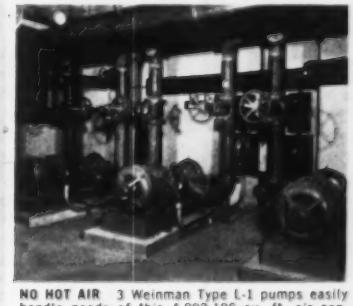
FREEDOM
from pumping worries

TAKES THE HEAT OFF This pair of 8" Type L-3 Weinman pumps supplys water to oil and hydrogen coolers for 30,000 k.w turbo-generator at Columbus and Southern Ohio Electric Company.

No problems here with big capacity Weinman Type L Pumps on the job

It takes a pump with a lot of "work-ability" to give long-lasting, low-cost service on the big jobs shown here. These Weinman single-stage, split-case centrifugal pumps are built to outperform all others in heavy-duty, continuous operation. Available in 3 models for low, medium or high head service. Free Bulletin No. 1200SS gives complete information. Write for your copy today.

HOW TO MAKE A RAISE WITH FOUR OF A KIND 4 Weinman Type L-3 pumps boost filtered water from clear water chambers under beds to 50' elevated storage tank at municipal pumping station. Day-in, day-out service is no strain for these units . . . maintenance costs are negligible.

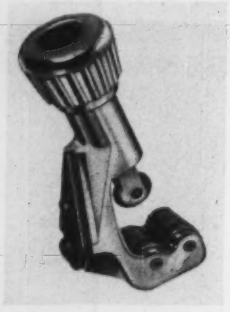


NO HOT AIR 3 Weinman Type L-1 pumps easily handle needs of this 4,902,196 cu. ft. air conditioning plant for large Federated Department Store. Efficient Weinman pumps deliver rated capacity at wear-saving motor speeds. Cost much less to own and operate.

THE WEINMAN PUMP MFG. CO.
290 SPRUCE ST. COLUMBUS 8, OHIO

Centrifugal Specialists

EQUIPMENT DEVELOPMENTS
Continued



Tube Cutter . . .

. . .to give increase in size range, faster cutting, and greater versatility —*Imperial Brass Mfg. Co., Dept. HPAC, 6300 W. Howard St., Chicago.*

Capacity of "Hi-Duty 274-FA" tube cutter increased to handle 1/8 to 1 1/8 in. OD tubing, hard or soft temper. Larger cutting wheel for faster cutting. Features cited: retractable reamer; flare cutoff groove permitting cutoff of damaged flares; free-wheeling ball thrust bearings for quick size adjustment.

Hex Wrench . . .

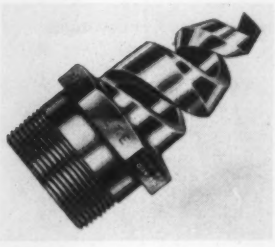
. . .with adjustable four sided jaw—*Ridge Tool Co., Dept. HPAC, Clark St., Elyria, Ohio.*

Angular jaw design of "Rigid" hex wrench said to give added leverage, positive grip on hex nuts, square nuts, valve packing nuts, unions, gas cocks, rough or finished. Wrench has narrow jaws with heavy-duty construction. Available in three sizes: "No. 11"—3/8 to 3/4 in.; "No. 17"—5/8 to 1/4 in.; "No. 25" — 1 to 2 in. nuts.

Prefabricated Piping . . .

. . .with new closing method—*E. B. Kaiser Co., Dept. HPAC, 2114 W. Lake Ave., P. O. Box 47, Glenview, Ill.*

Quick coupler, coupling, and telescoping end now available. Flanged cast iron casings, solid sleeve and mechanical joint closing methods all may be supplied. Bulletin "No. 111" describes company's line.



Fog Nozzle . . .

. . .designed for protection of transformers from fire—*Bete Fog Nozzle, Inc., Dept. HPAC, 309 Wells St., Greenfield, Mass.*

"N-9" nozzle said to be nonclogging due to use of patented spiral element for spray generation. Four nozzles per transformer said to be sufficient for full protection. Unit delivers 100 gpm at 25 psi with 75 deg full cone spray made of cast bronze, unit has 1 1/2 in. male pipe thread.

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Continental Air Filters, Inc.
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Dollinger Corporation
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Rochester 3, New York

Drico Industrial Corporation
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*Technical Filter Co.
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PRE-FAB-RIC
A PREFABRICATED FLEXIBLE DUCT CONNECTION
Simply pull out desired length from dispenser-type carton. (It pulls out ready to use.)
Roll into round duct or form into square duct and join. Saves 70% time over old methods.
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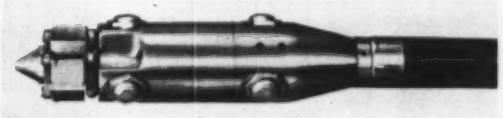
EQUIPMENT DEVELOPMENTS

Continued

Metal Connectors . . .

. . . with braid design intended to provide high burst strengths—*Korfund Co., Inc., Dept. HPAC,* 48-01 *F 32nd Pl., Long Island City* 1, *N. Y.*

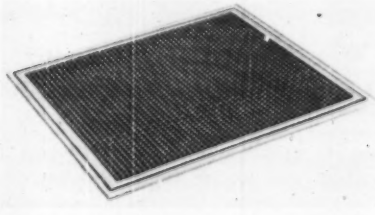
"Flex-Hose" flexible metal hose sections attenuate transmission of vibration and pulsations into rigid piping, compensate for misalignment, reduce strain on piping. Constructed of corrugated, seamless tubing, protected and reinforced by outer braiding. Tubing and braid available in bronze or steel, depending on operating conditions. Maximum working pressures at 70 F vary with size to 1700 psi. Operating temperatures to 750 F, depending on materials. Available for seven pipe sizes, 5 to 16 in. ID; stock lengths: 31 to 72 in.



Tube Reamer . . .

. . . designed to reduce task of cleaning coal, oil, or gas fired boiler tubes to one man job—*Viking Research Corp., Dept. HPAC,* 618 *Indiana Ave., Sheboygan, Wis.*

With "Jet-Air" tube reamer, compressed air used to rotate four steel scrapers at high speed. Soot, scale cut from boiler tube walls and blown forward into breeching at end of tube. Tool operates on 60 to 90 psi air pressure. Motor rotates four steel scrapers at 4000 to 5000 rpm; centrifugal force provides cutting pressure.



Air Diffusers . . .

. . . with matching return or exhaust units—*Air Devices Inc., Dept. HPAC,* 185 *Madison Ave., New York.*

"Perfair" air diffusers incorporate interchangeable cores available in unlimited air pattern arrangements for one, two, three, or four way blows. Units include air controllers for positive adjustment of air deflection after unit is installed. Perforated face plate blends with acoustical ceilings.

The Kangaroo Who Forgot How To Hop

Once upon a time . . .

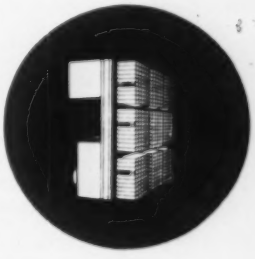
there was an old Roo who decided to rest on his laurels. He had a pouch full of aboriginal air filter designs and wouldn't specify anything new.

His plan boomeranged when he discovered that modern air handling systems required new designs in air filters. He realized he had to get hopping or he'd be left down-under. He tried . . . but the old bounce just wasn't there.

One day his friendly Far-Air man showed him the new Hi-Kleen, a semi-automatic, disposable media filter which combined two stage filtration in a compact unit. The old Aussie took one look and knew he was back in the game.

Moral:

Compare before you specify. The Hi-Kleen is only one of the new Far-Air Filters that will better meet modern requirements. Slip the coupon below in any mailman's pouch.



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Boomerang me the new bulletin on Hi-Kleen Filters.

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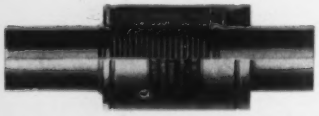
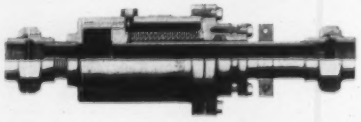
Sylphon Packless Expansion Joint No. 1291

Two major improvements now make this widely-used Fulton Sylphon Packless Expansion Joint your best buy for absorbing pipe line expansion. Traverse is up 33% to a total of 2". Working pressure limit is increased by 50% to a new high of 150 lbs. Stainless steel multi-ply Sylphon® Bellows is internally guided and equipped with anti-torque feature...stays foolproof for years and years. No packing maintenance . . . no installation worries. Delivered fully assembled ready to install in vertical or horizontal steam or water lines. Pipe sizes ¾" to 3".



New No. 1290 low pressure type Packless Expansion Joint for steam or hot water lines. Special packing gives dual protection against leakage. ¾" traverse. 60 lbs. pressure. Pipe sizes ¾" to 2".



No. 111-M Packless Expansion Joint features powerful corrosion-resistant Monel bellows plus emergency packing. This is the ultimate in materials and quality design for hot or chilled water lines. 1½" traverse. Pipe sizes ¾" to 3".

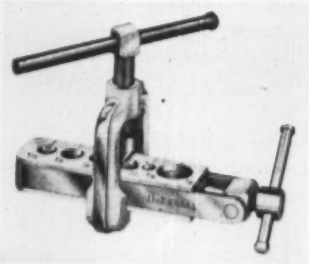
WRITE FOR BULLETIN XH-65

Robertshaw-Fulton CONTROLS COMPANY

FULTON SYLPHON DIVISION • Knoxville 1, Tenn.

EQUIPMENT DEVELOPMENTS

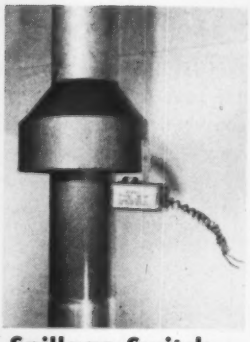
Continued



Flaring Tool . . .

. . . in 45 deg design intended to provide faster more accurate operation —*Imperial Brass Mfg. Co., Dept. HPAC, 6300 W. Howard St., Chicago. 48.*

"Hi-Duty 300-F" has self-gaging, chevron gripping action and high strength flare radius. Also has die recess for automatic forming of flares to conform to exact dimensions. Chamfer in each flaring die has definite radius at base. Flares on six tube sizes—3/16, ¼, 5/16, ⅜, ½ and ⅝ in. OD—in soft copper, aluminum, and brass can be made. Tool finished in chrome nickel.



Flue Spillage Switch . . .

. . . designed to shut off gas burner in heating system when flue products spill from draft diverter into occupied space—*Wilson Industries, Inc., Dept. HPAC, 3831 Bedford Ave., Brooklyn.*

"Spilswitch" consists of thermal disc which responds to presence of flue products by closing gas supply and shutting off burner. Unit positioned at relief opening of diverter. Specific models for horizontal, vertical, and barometric diverters. May also be used with gas water heater installations.

WHERE THERE'S BUSINESS ACTION THERE'S A BUSINESSPAPER

Some blessings we take for granted. Like ice cubes. Or indoor plumbing. However, older men—wiser men—say a little prayer of thanks for things they know they couldn't do without.

Among these wiser men are the men who make top-level decisions in business.

To make decisions, they must have facts. All the facts. All the pertinent information they can get. And they get a major portion of that information from one unique source: the business publications they subscribe to.

No businessman is fully informed until he reads his businesspaper. He reads it for profit, not for pleasure. He searches it through for news of the trade or industry. For facts. For fresh ideas. For new products he can put to work. And he reads the advertising with the same intense concentration he devotes to the editorial pages.

He knows that his businesspaper is vital to his success—to his very livelihood. And he says a little prayer of thanks.

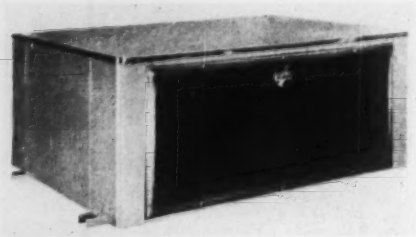
Every man on the way up can profit from his example. Take a tip from the reading habits of key men at every level. Take out a subscription of your own. Read every issue...and read it searchingly. It's *your* businesspaper, too.

Heating Piping & Air Conditioning
6 North Michigan Ave., Chicago, Ill.

One of a series of advertisements prepared by THE ASSOCIATED BUSINESS PUBLICATIONS

EQUIPMENT DEVELOPMENTS

Continued



Air Conditioners . . .

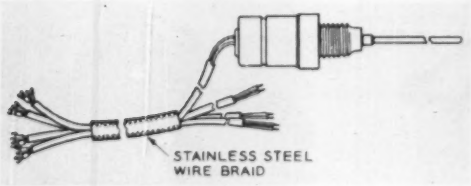
. . . in two larger sizes of 7½ and 10 tons—*Refrigeration Appliances, Inc., Dept. HPAC, 923 W. Lake St., Chicago.*

Additions to "Komfort Master" line give total of five sizes from 2 to 10 tons. Units made in three models: double blower in larger models, single blower in smaller models; stripped or cabinetless units for furred-in installations. Designed for ceiling installation but engineered to permit floor installation. Adaptable for use with ducts. Velocities modulated to suit conditions by volume control damper.

Air-Water Cooled Condensers . . .

. . . designed to operate as normal air cooled condenser at selected ambient temperature, then have condenser capacity supplemented by use of water—*Dunham-Bush, Inc., Dept. HPAC, West Hartford, Conn.*

Water side condensing surface acts as safety device, designed to handle complete condensing load in event of failure of air cooled system. Construction of new, combination "BCW" unit same as that of "BC" condensers with exception of condenser coil. Water circuit fitted by utilizing inner tube used to support inner fin of condenser coil.



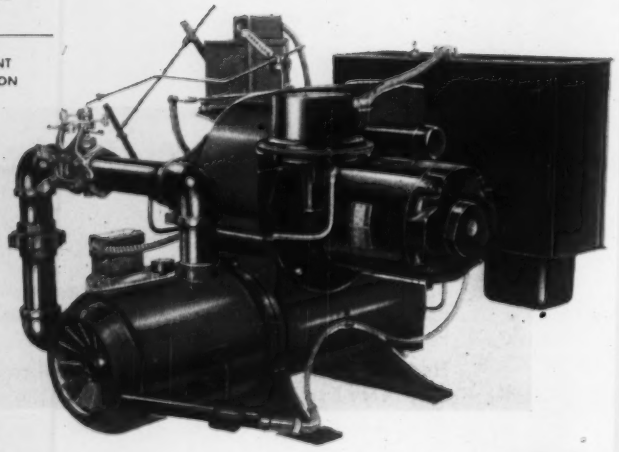
Thermocouple . . .

. . . for measuring temperatures up to 2000 F at pressures to 50,000 psi—*Bristol Co., Dept. HPAC, P. O. Box 1790, Waterbury 20, Conn.*

Metal sheathed, ceramic insulated thermocouple may be bent around twice its own diameter for access to difficult locations. Sheathing available in stainless steel and nickel alloy in diameters 1/16 to ¼ in., lengths to 30 ft. Wire down to No. 30 AWG can be used. Thermocouples available in iron-constantan, copper-constantan, other materials.

COMPLETE PACKAGE
SIMPLE INSTALLATION
LOW FIRE START
EFFICIENT OPERATION
FIRE TESTED
FULLY APPROVED
FACTORY GUARANTEED

HEV-E-DUTY POWER GAS BURNERS



Engineered for top performance under all weather conditions

Precision-engineered Hev-E-Duty power gas burners are the low-cost answer to high heating efficiency with gas. Automatic electric ignition assures safe starting. Built-in low fire start that builds up slowly to the flame size required means smooth, safe operation. Minimum low fire and maximum high fire can be controlled exactly for top efficiency with any boiler or furnace.

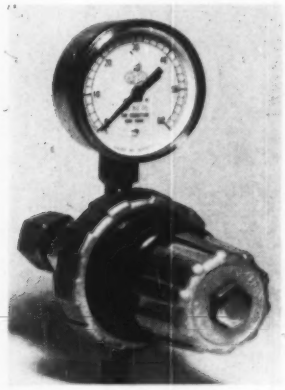
Once set, the burner maintains this setting automatically regardless of weather. Sizes from 720,000 to 21,000,000 BTU. Hev-E-Oil and combination gas/oil models also available. For more information write Industrial Combustion, Inc., 4507 N. Oakland Ave., Milwaukee 11, Wis., Dept. HPA-12.

INDUSTRIAL COMBUSTION INC.

EXECUTIVE OFFICE: 4507 N. OAKLAND AVE., MILWAUKEE 11, WISCONSIN

EQUIPMENT DEVELOPMENTS

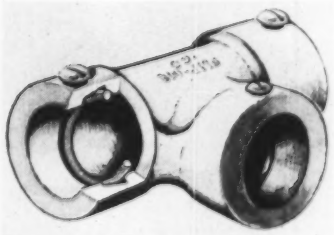
Continued



Gas Regulator . . .

. . . intended for low pressure service —*Air Reduction Sales Co., Inc., Div. of Air Reduction Co., Inc., Dept. HPAC,* 150 *E.* 42*nd St., New York.*

Single-stage inverse type "Airco 9900" station gas regulators have large effective area of flexible diaphragm. Designed for handling inlet pressure to 300 psi. Body of unit is machined brass forging with hexagon section intended to simplify disassembly. Hand tightening seals against leakage by means of rubber ring on diaphragm. Molded rubber diaphragm has nylon fabric insert. Adjusting screw is forged brass knob with ribbing.



Threadless Pipe Fittings . .

. . . developed to work equally well with galvanized, black iron or standard plastic pipe—*Slip-On Co., Dept. HPAC,* 436 *Magnolia, N. W., Atlanta, Ga.*

Line of threadless, galvanized fittings, ½ through 2 in., built with neoprene O-ring lodged in wedge shaped groove. Slip-on fittings make unions unnecessary, according to manufacturer.

Costs Less...
No Maintenance!

Flexon®

HIGH-PRESSURE, HEAVY-DUTY EXPANSION COMPENSATOR

Inch for inch, the lowest-cost way to take care of pipe motion

Never needs maintenance, because it's completely packless

Heliarc welded construction . . . and steel-encased for protection from external damage

Its 2-ply stainless steel Flexon bellows is designed to outlast the building

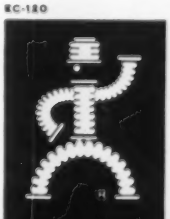
INSTALL IT . . . FORGET IT!

You can bank on it . . . Flexon Model H Expansion Compensators cost much less per inch of stroke than *any other method* of absorbing pipe expansion! Yet the Model H is built for hard service, with its 2-ply stainless steel Flexon bellows, positive internal guide and anti-torque device, and full protection from external damage.

This is why engineers and piping contractors are specifying the Model H for thousands of industrial piping jobs—in heating systems, process piping, steam tracing, power piping—that use pipe up to 3" and require up to 2" total movement at each Expansion Compensator. Working pressures to 175 p.s.i. for ¾" and 1" sizes; to 125 p.s.i. for larger sizes up to 3".

Make the Flexon Model H Expansion Compensator a cost-cutting part of your next piping job. Write for design and cost data, and the name of your Flexon representative.

EC-120



Flexonics corporation

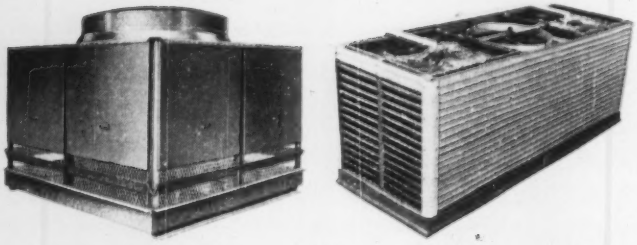
EXPANSION JOINT DIVISION • 1391 S. THIRD AVENUE, MAYWOOD, ILLINOIS

EXPANSION JOINTS · METAL HOSE · NON-METALLIC HOSE · BELLOWS · AIRCRAFT COMPONENTS

IMPORTANT NEWS FOR COOLING TOWER BUYERS

Dover "Packaged" Cooling Towers Join Famous Pritchard Line

J. F. Pritchard & Co. of California and Dover Manufacturing Company merged October 1 to offer one of the most complete range of cooling tower sizes and types in the industry. Dover's line of "packaged" towers plus Pritchard's field-assembled towers can answer the requirements of any water cooling job. Write for catalog details.



SILLOWETTE LOLINE

INDUSTRY'S PARTNER FOR PROGRESS

COOLING TOWERS
GAS & AIR TREATING EQUIPMENT

REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

J.F. Pritchard & Co.
OF CALIFORNIA
4625 Roanoke Parkway, Kansas City 12, Mo.

EQUIPMENT DEVELOPMENTS

Continued

Charging Hoses . . .

. . . intended for color coding when charging air conditioning system—*Superior Valve & Fittings Co., Dept. HPAC, 1509 W. Liberty Ave., Pittsburgh 26.*

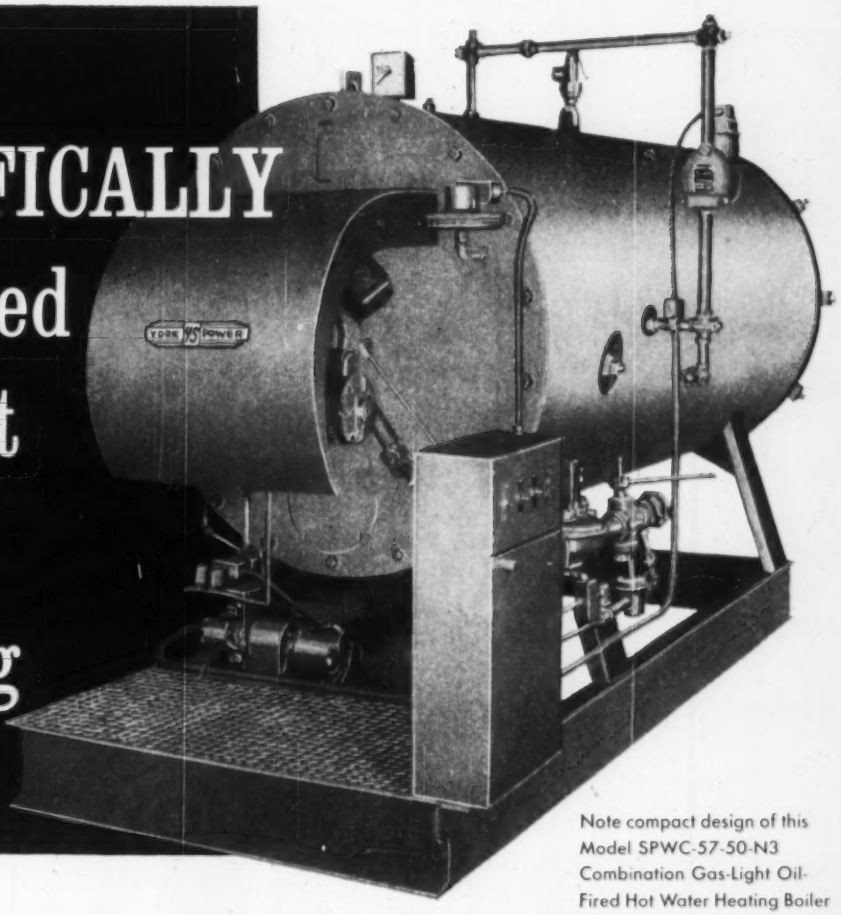
Pack of three charging hoses contains red, white, and green hose for visual separation of high side, charge line and low side. Each hose 36 in. long, made of neoprene holding charge up to 500 psi working pressure. Solid brass quick-couplers are heavily knurled with full flare engagement on both straight and 45 deg angle couplers. Soft composition gasket gives quick seal, says manufacturer.

Pipe Fitting . . .

. . . in design combining line cap and extension fitting for 2 in. gas mains—*Dresser Mfg. Div., Dresser Industries, Inc., Dept. HPAC, 49 Fisher Ave., Bradford, Pa.*

"Stop-N-Go" pipe fitting first used as terminal fitting for 2 in. mains. When main is extended, end nut and line cap removed from extension end. Extensions made without shutting off main as long as pressures do not exceed 30 psi while extension is made. Fitting will accommodate working pressures to 60 psi. Has 1/4 in. purging outlet.

SPECIFICALLY Designed For Hot Water Heating



Note compact design of this Model SPWC-57-50-N3 Combination Gas-Light Oil-Fired Hot Water Heating Boiler

York-Power Packaged Boiler Overcomes Operational Problems for All Types of Hot Water Heating Installations

The use of steam boilers for hot water heating, although accepted, has been inefficient and especially costly from a maintenance point of view because of internal shock and condensation. Now, York-Power engineers have achieved another first—the development of a completely packaged boiler designed *specifically* for hot water heating.

These advanced new units may be used for continuous heat delivery at varying rates of heat flow or for intermittent heat delivery at fixed rates of flow. To serve these two basic systems, York-Power engineers had to face up to and solve new problems not heretofore fully realized.

Here are the solutions:

1. *Elimination of Shock and Condensation* through proper use of mixing valves and an anti-shock control.

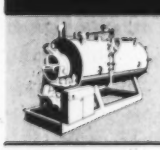
2. *Improved Water Circulation and Air Elimination* by reverse water flow through boiler supply water diffuser tube, and proper air venting.

3. *Lower Installation Costs* with factory-mounted and wired circulator and low-water cut-off and use of all-welded and flanged piping.

In addition, these new boilers mean worthwhile fuel economies because of their unitary design. They operate on gas as well as low-cost heavy fuel oils or lighter fuel oil. Models for combination gas/oil firing are also available.

Now available in 14 sizes ranging from 26 H. P. to 500 H. P. Shipped complete—and factory tested. S. B. I. rated. Use these York-Power boilers on your next heating job. Mail the coupon for complete specifications TODAY!

Industrial Division **YORK-SHIPLEY, Inc.** YORK, PA.



STEAM-PAK
15 to 600 Hp.
Oil and/or Gas Firing

PAKETTE
10 to 50 Hp.
Oil and/or Gas Firing

FIRE-PAK
35 to 485 Hp.
Oil and/or Gas Firing

SCOT-PAK
52 to 400 Hp.
Oil and/or Gas Firing

Industrial Division—York-Shipley, Inc., York, Pa.
Please send me new illustrated brochure giving full details about York-Power's new line of Hot-water Boilers.

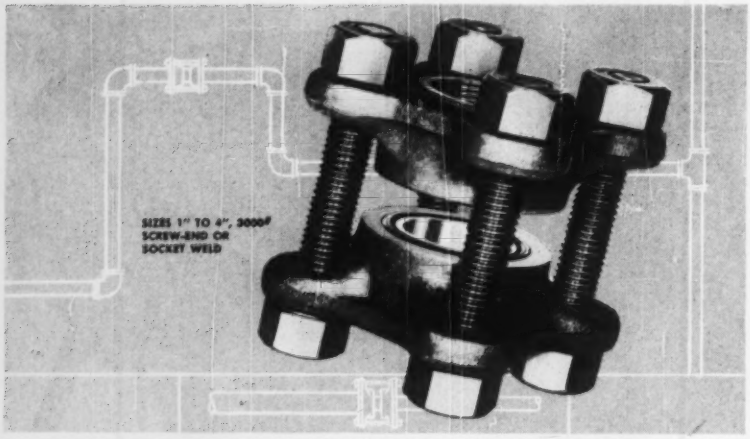
NAME _____

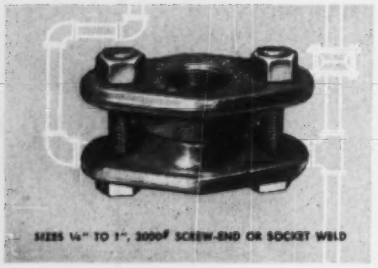
COMPANY _____

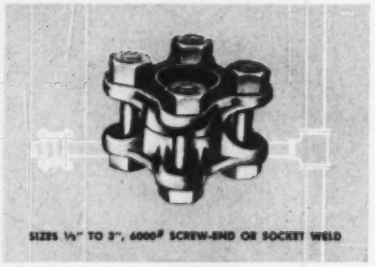
STREET _____

CITY _____ ZONE _____ STATE _____

The double diamond assures double value







Installation flexibility with permanent piping strength

GET BOTH WITH W-S O-RING FLANGE UNIONS

NOW, you can install high pressure piping systems that can easily be rearranged and adapted with full assurance that the unions will give the leak-proof service of permanent installations. This is made possible by these adaptable features of W-S O-Ring Flange Unions:

- Available in 2-bolt and 4-bolt types, according to size.
- Sizes ¼" to 1" in 2-bolt 3000#; sizes 1" to 4" in 4-bolt type 3000#; sizes ½" to 3" in 4-bolt type only 6000#.
- Available in Screw-end and Socket Welding Types—3000# and 6000#.
- O-Rings available in a variety of materials for a wide range of service.

Specify forged steel W-S O-Ring Flange Unions for a tight seal against fluid pressure in piping for hydraulic machinery, refrigeration piping, steam and water lines, process liquid and gas lines, and many other applications.

For full specifications, write for Bulletin U-1-58

W-S manufactures a full range of high quality drop forged fittings, unions and couplets . . . in carbon, stainless and alloy steels. For full information about these products, or for your specification forging requirements, write to: W-S Fittings Works, H. K. Porter Company, Inc., Box 95, Roselle, N. J.

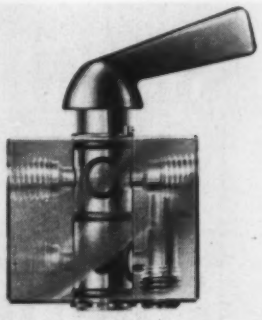
H. K. PORTER COMPANY, INC.

FORGE AND FITTINGS DIVISION

W-S Fittings Works, Roselle, N. J. • Cleveland Forge Works, Cleveland 4, Ohio
Stainless Steel Works, Duncannon, Pa.

EQUIPMENT DEVELOPMENTS

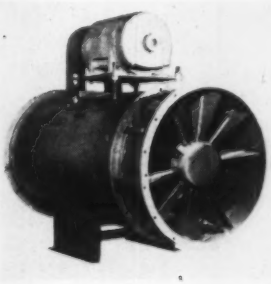
Continued



Three-way Plug Valve . . .

. . . designed to give leakproof shutoff to prevent external and body leakage —*Circle Seal Products Co., Dept. HPAC,* 2181 *E. Foothill Blvd., Pasadena, Calif.*

Sealing with O-rings on face of cylindrical plug and on diameter of plug gives tight seal without adjustment, says manufacturer. "Series 9300" general purpose valve has three ports arranged as three-way valves to provide one inlet, one outlet, one exhaust. When functioning as selector valve, one inlet and two outlets or two inlets and one outlet are provided. For both gas and liquid circuits.



Fan Inlet Vanes . . .

. . . developed for power saving at part-load operation of centrifugal fans—*Dryer Electric Corp., Dept. HPAC,* 164-166 *Wallabout St., Brooklyn 6.*

Volume of damper-equipped fans controlled manually or automatically at pressure desired. Non-binding vanes turned by low friction linkages in centered control box facilitate remote control of fan volume. Dampers available as integral part of company's "TC" fans.

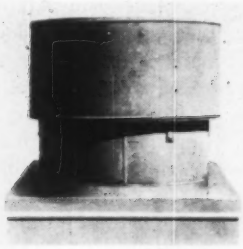
EQUIPMENT DEVELOPMENTS

Continued from page 190

Feedwater Treatment . . .

. . . formulated to present no special handling or storage problems—*Betz Laboratories, Inc., Dept. HPAC, Gillingham and Worth Sts., Philadelphia.* 24.

"Hyzeen" is 35 percent aqueous solution of hydrazine, non-flammable with neither flash nor fire point. Especially intended for the removal of oxygen from feedwater for high pressure boilers. Formula reacts with oxygen without adding dissolved solids to boiler water.



Roof Ventilators . . .

. . . with flat curb base for low silhouette—*E. Van Noorden Co., Dept. HPAC,* 122 *Magazine St., Boston* 19.

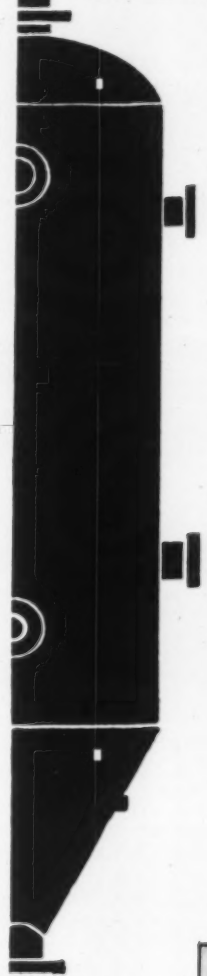
"Upblast" units designed to provide high velocity, large capacity, vertical discharge to remove excessive heat, smoke, fumes from over furnace, vats, tanks at rates to 86,000 cfm. Fan action opens dampers, provides rapid exhaust. Designed to fit any flat or pitched roof. Available in 26 models to exhaust from 1628 to 86,000 cfm.

Temperature Controls . . .

. . . designed to enable hospital patients to adjust temperature—*Minneapolis-Honeywell Regulator Co., Dept. HPAC,* 2753 *Fourth Ave., S., Minneapolis* 8.

Control center developed in collaboration with hospital officials to reduce costs of patient care. Switches, pushbuttons, knobs mounted on small panel of control center on bedside table within reach of patient. With control panel, patient may regulate heating or air conditioning of hospital room, make other comfort adjustments.

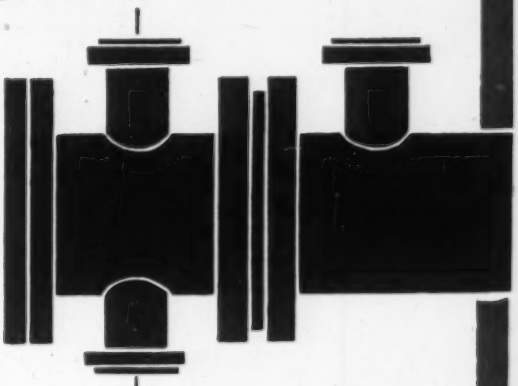
Announcing
CORROSION CONTROLLED VESSELS



NOW stop corrosion before it starts in new storage vessels. Specify a Novelon lined vessel from Ellicott to prevent corrosion, rusty water; contaminated contents.

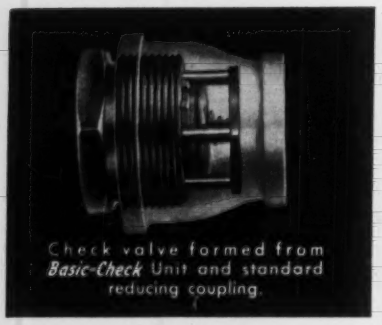
Ellicott has combined its fifty years of building unfired pressure vessels and storage tanks—with ten years of developing a complete line of Novelon Linings of cement, rubber, lead, copper and the new plastic linings that allow much higher heat resistance.

Novelon linings solve the corrosion problems in storing and processing water, acid, food and chemicals. Send us your corrosion problems today.

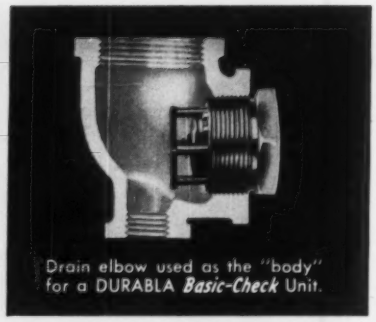


Specify ELLICOTT
THERE'S NO EQUAL

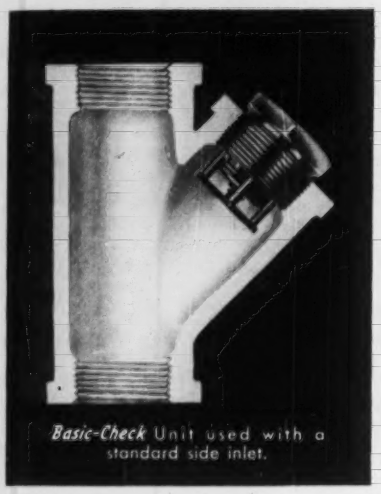
Representatives in Major Cities
Clare and Kloman Streets • Baltimore 30, Maryland



Check valve formed from *Basic-Check* Unit and standard reducing coupling.



Drain elbow used as the "body" for a DURABLA *Basic-Check* Unit.



Basic-Check Unit used with a standard side inlet.

Basic-Check Unit at inlet end of this bend completes the check valve.

How you can "make" a check valve to meet any emergency

Just take a DURABLA *Basic-Check* Unit . . . combine it with a standard pipe fitting . . . and you have a complete check valve that's perfect for practically any service. Keep a few *Basic-Check* Units on hand and you are prepared for any emergency.

Because it will operate in any position, the DURABLA *Basic-Check* Unit can be installed without changing existing lines. Made of stainless steel, they'll handle almost any liquid, gas or air . . . over a broad range of pressure-temperature ratings.

DURABLA *Basic-Check* Units are versatile, dependable, efficient and inexpensive. They come in seven standard line sizes, from ⅜" to 2". Also available: DURABLA Reducing Couplings of stainless steel.

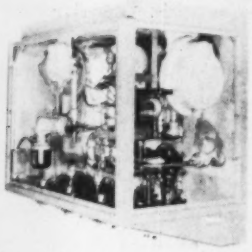
Ask for a copy of Bulletin HPAC-128.

DURABLA MANUFACTURING COMPANY
114 Liberty Street, New York 6, New York

DURABLA®

DM-32

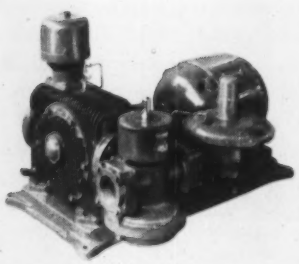
EQUIPMENT DEVELOPMENTS
Continued



Blowdown System . . .

. . . in fully automatic design—*Fred H. Schaub Engineering Co., Dept. HPAC, 2110 S. Marshall Blvd., Chicago 23.*

System includes automatic sample cooling; illuminated sight flow indicators; stainless steel "knife-closure" dial-calibrated volume-control valves; automatic drain aftercooling; automatic, timed, pressure flush for strainer drains, flash tank, other items. Console cabinet has pressure, temperature, level instrumentation. Accommodates two, three, four blowdown stations with total capacity up to 5000 lb blowdown per hr for either 250 or 600 psi maximum working pressure.



Propane Diluter . . .

. . . developed to automatically supply accurate mixtures of propane and air, or butane and air—*Selas Corp. of America, Dept. HPAC, Dresher, Pa.*

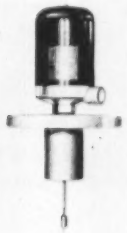
Propane diluters can be connected to existing gas piping and eliminate need for dual piping, separate blowers, inspirator mixers, etc. Design incorporates balanced pressure, full-floating mixing valve with precision gas and air metering ports. Valve can be adjusted for precise control of gas-air ratio. Capable of turndown through range of 50:1.

EQUIPMENT DEVELOPMENTS
Continued

Plastic Pipe . . .

. . . developed for use with natural gas lines, chemical piping, deep well piping—*Carlon Products Corp., Dept. HPAC,* 10225 *Meech Ave., Cleveland* 5.

"HTHT" plastic pipe made from kralastic resin can be used at temperatures to 180 F with tensile strength allowing high working pressure ratings. Pipe resistant to rust, electrolytic corrosion, corrosion from soil condition. Available in sizes ½ through 6 in. for working pressures of 100, 125, 150, 200 psi and in special "Schedule 80 IPS" for working pressures to 500 psi.



Pump Controls . . .

. . . designed to provide wide differential for control of two pumps or one pump and high or low alarm—*Magnetrol, Inc., Dept. HPAC,* 2110 *S. Marshall Blvd., Chicago* 23, *Ill.*

"Model A-102F Tandem" and "A-103-F Tandem" for flanged mounting and "A-102 Tandem" and "A-103 Tandem" for screwed mounting change switch actuation points by sliding displacers up or down as desired. Units are factory set for individual application requirements. Factory settings range 0.35 specific gravity to 1.8, depending on displacer material furnished. All models provided with glazed porcelain displacers as standard.

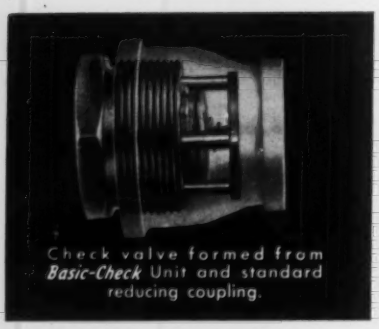
100 percent air recirculation? you're crazy!

Total recirculation isn't the answer in every case but it gives the best purity and the lowest cost for many ventilating situations. The point is, Barnebey-Cheney activated charcoal air purification *lets you design for total recirculation* of inside air, and save substantially in both initial investment for heating and cooling equipment and operating costs.

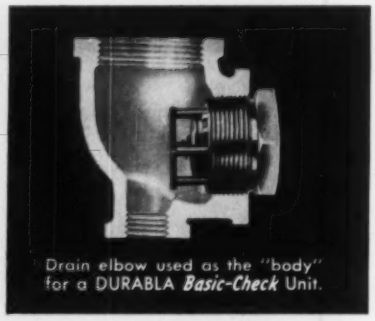
A typical well designed system uses outside air in the spring and fall for cooling and 100% recirculation with activated charcoal purification in the summer and winter. In most buildings normal infiltration and the opening of doors provides plenty of oxygen. Pressurizing of the building can be incorporated if desired. Write for Bulletin T-321. Barnebey-Cheney, Columbus 19, Ohio.

activated charcoal air purification

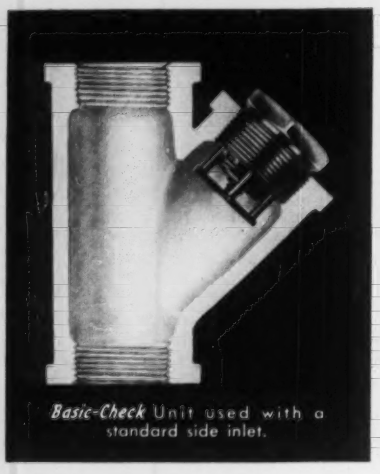
Barnebey Cheney



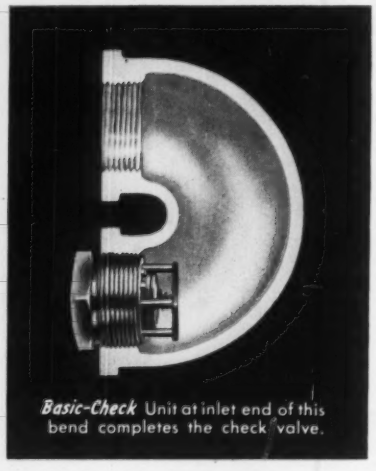
Check valve formed from *Basic-Check* Unit and standard reducing coupling.



Drain elbow used as the "body" for a DURABLA *Basic-Check* Unit.



Basic-Check Unit used with a standard side inlet.



Basic-Check Unit at inlet end of this bend completes the check valve.

How you can "make" a check valve to meet any emergency

Just take a DURABLA *Basic-Check* Unit . . . combine it with a standard pipe fitting . . . and you have a complete check valve that's perfect for practically any service. Keep a few *Basic-Check* Units on hand and you are prepared for any emergency.

Because it will operate in any position, the DURABLA *Basic-Check* Unit can be installed without changing existing lines. Made of stainless steel, they'll handle almost any liquid, gas or air . . . over a broad range of pressure-temperature ratings.

DURABLA *Basic-Check* Units are versatile, dependable, efficient and inexpensive. They come in seven standard line sizes, from ⅜" to 2". Also available: DURABLA Reducing Couplings of stainless steel.

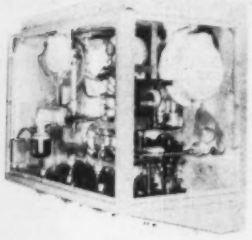
Ask for a copy of Bulletin HPAC-128.

DURABLA MANUFACTURING COMPANY
114 Liberty Street, New York 6, New York

DURABLA®

DM-32

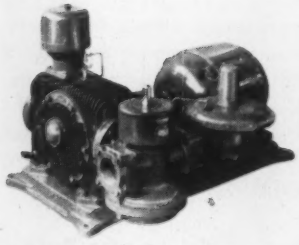
EQUIPMENT DEVELOPMENTS
Continued



Blowdown System . . .

. . . in fully automatic design—*Fred H. Schaub Engineering Co., Dept. HPAC, 2110 S. Marshall Blvd., Chicago 23.*

System includes automatic sample cooling; illuminated sight flow indicators; stainless steel "knife-closure" dial-calibrated volume-control valves; automatic drain aftercooling; automatic, timed, pressure flush for strainer drains, flash tank, other items. Console cabinet has pressure, temperature, level instrumentation. Accommodates two, three, four blowdown stations with total capacity up to 5000 lb blowdown per hr for either 250 or 600 psi maximum working pressure.



Propane Diluter . . .

. . . developed to automatically supply accurate mixtures of propane and air, or butane and air—*Selas Corp. of America, Dept. HPAC, Dresher, Pa.*

Propane diluters can be connected to existing gas piping and eliminate need for dual piping, separate blowers, inspirator mixers, etc. Design incorporates balanced pressure, full-floating mixing valve with precision gas and air metering ports. Valve can be adjusted for precise control of gas-air ratio. Capable of turndown through range of 50:1.

EQUIPMENT DEVELOPMENTS
Continued

Plastic Pipe . . .

. . . developed for use with natural gas lines, chemical piping, deep well piping—*Carlon Products Corp., Dept. HPAC,* 10225 *Meech Ave., Cleveland* 5.

"HTHT" plastic pipe made from kralastic resin can be used at temperatures to 180 F with tensile strength allowing high working pressure ratings. Pipe resistant to rust, electrolytic corrosion, corrosion from soil condition. Available in sizes ½ through 6 in. for working pressures of 100, 125, 150, 200 psi and in special "Schedule 80 IPS" for working pressures to 500 psi.

Pump Controls . . .

. . . designed to provide wide differential for control of two pumps or one pump and high or low alarm—*Magnetrol, Inc., Dept. HPAC,* 2110 *S. Marshall Blvd., Chicago* 23, *Ill.*

"Model A-102F Tandem" and "A-103-F Tandem" for flanged mounting and "A-102 Tandem" and "A-103 Tandem" for screwed mounting change switch actuation points by sliding displacers up or down as desired. Units are factory set for individual application requirements. Factory settings range 0.35 specific gravity to 1.8, depending on displacer material furnished. All models provided with glazed porcelain displacers as standard.

100 percent air recirculation? you're crazy!

Total recirculation isn't the answer in every case but it gives the best purity and the lowest cost for many ventilating situations. The point is, Barnebey-Cheney activated charcoal air purification *lets you design for total recirculation* of inside air, and save substantially in both initial investment for heating and cooling equipment and operating costs.

A typical well designed system uses outside air in the spring and fall for cooling and 100% recirculation with activated charcoal purification in the summer and winter. In most buildings normal infiltration and the opening of doors provides plenty of oxygen. Pressurizing of the building can be incorporated if desired. Write for Bulletin T-321. Barnebey-Cheney, Columbus 19, Ohio.

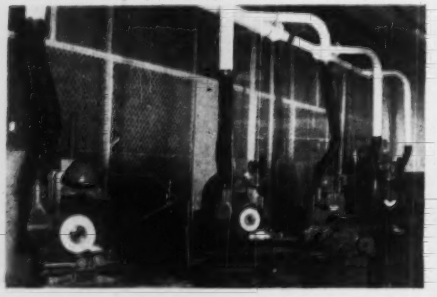
activated charcoal air purification

Barnebey Cheney

SEE US AT BOOTH 448, INTERNATIONAL
HEATING & AIR CONDITIONING EXPOSITION

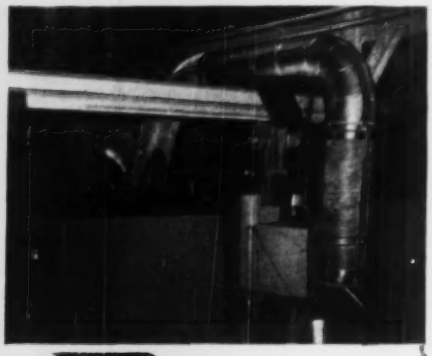
how exhaust systems at Westinghouse use Wiremold Flexible Air Duct . . .

Photos courtesy of Westinghouse Electric Corporation



GLASS SANDING machine fine-sands or polishes glass fibre boards and mica glass. Dust particles are removed by suction through a sharply curved length of Wiremold Flexible Air Duct.

SURFACE GRINDING machines use Wiremold on the exhaust system, so that each collection head can move back and forth with the machine head, and can be adjusted to machine height easily.

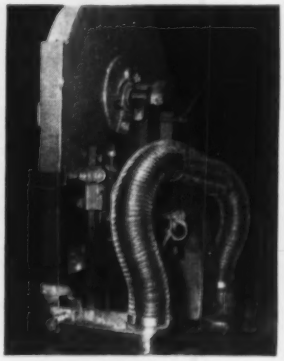


ELECTRIC BRAZING machine uses Wiremold to exhaust fumes. The Flexible Air Duct permits horizontal travel and vertical adjustment without disturbing the exhaust system.

GLASS CUTTING machine uses Wiremold to remove glass dust and particles. Flexibility of the duct makes it easy to adjust the machine to the height and length of the cutting operation.

CONSTRUCTION Exclusive Wiremold construction locks fabric to metal — guarantees long life. No adhesives are used.

WRITE FOR FULL INFORMATION



WIREMOLD® FLEXIBLE AIR DUCT

for exhausting... air conditioning... materials handling

THE WIREMOLD COMPANY, HARTFORD 10, CONNECTICUT

EQUIPMENT DEVELOPMENTS

Continued

Arc Welder . . .

. . . in combination 200 amp d-c welder and power unit of 5 kw a-c capacity—*Hobart Bros. Co., Dept. HPAC, Hobart Square, Troy Ohio.*

D-c welding current (for either straight or reverse polarity electrodes) provided instead of a-c welding current with a-c power in new "PowrWeld." Welding generator rated 200 amp at 25 volts on 100 percent duty cycle with welding range of 30 to 225 amp for intermittent use. Generator provides 5 kw, 110/220 volt, single phase, 60 cycle a-c power. Engine coupled to generator to form unit 38 × 21¼ × 25¾ in. Weight of unit 620 lb.

Water Heater . . .

. . . in design eliminating booster tank—*Republic-Odin Appliance Corp., Dept. HPAC,* 2231 *Randolph St., Huntington Park, Calif.*

"No. 336 Hi-Recovery 8-Flue Circulator" has input of 240,000 Btu per hr, produces 180 F water. Suggested applications include apartment, office, industrial buildings.

Equipment Briefs . . .

ALUMINUM SOLDERING FLUX intended to promote capillary action on aluminum—*American Solder & Flux Co., Dept. HPAC,* 19*th and Willard Sts., Philadelphia* 46. May be used to join aluminum to aluminum or aluminum to other metals. According to manufacturer, it is pos-

EQUIPMENT DEVELOPMENTS

Continued

sible to draw solder between two pieces of aluminum even in vertical position. Operating temperature 600 to 675 F. Residue may be removed with water.

MASONRY DRILL for use with concrete, marble, granite, cement, brick, tile, other hard, brittle nonmetallic materials—*Diamond Core & Saw Div. of Portomag, Inc., Dept. HPAC,* 1521 *E. Nine Mile, Detroit* 20. "Di-Cor" drilling machine equipped with 2¼ hp electric drill motor and integral water swivel to cool, flush away cuttings from cutting face of diamond drill. Can be operated from vertical or horizontal position, swung through 360 deg.

ELECTRODES for making high strength joints in alloy steels—*Lincoln Electric Co., Dept. HPAC,* 22801 *St. Clair Ave., Cleveland* 17. "Jetweld LH-90" and "Jetweld LH-110" are iron powder, low hydrogen electrodes designed to increase deposit rates, improve operating characteristics. Intended for use on high temperature, high pressure piping, steel fabrication.

MOTOR STARTER for single phase applications up to 5 hp — *General Electric Co., Dept. HPAC, Schenectady* 5, *N. Y.* Integral horsepower motor starter available for control of a-c single phase, rated 3 hp 115 volts, or 5 hp 230 volts. It is a 4 pole, size 1 starter with 2 poles wired in parallel on each side of line.

GAS DETECTORS for field testing portable combustible gas indicator — *Johnson-Williams, Inc., Dept. HPAC,* 2715 *Park Blvd., Palo Alto, Calif.* Kit utilizes known percentage mixture of methane and air for checking reading on gas indicator's meter. Ampoule of methane is broken into plastic squeeze bottle and methane-air mixture is fed into indicator by squeezing bottle.

INTERNATIONAL-LaMONT—proven superiority for HIGH TEMPERATURE WATER GENERATION

Over 2 BILLION Btu./Hr.

(2,010,800,000 Btu/hr.)

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Continental Can Co.
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Johnson & Johnson
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Otis, Mass.
Mountain Home, Idaho
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Westover, Mass.
K. I. Sawyer, Mich.
Minot, North Dakota
Suffolk County, N. Y
Glasgow, Montana
Truax, Wisconsin
Clinton County, Ohio
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U.S. NAVY BASES
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Columbus, Ohio
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Hilltop Elementary School
American River Jr. College
Madeira High School
Brigham Young University
Indian Hill Elementary School
Holy Apostles School
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HOSPITALS
Loring AFB Hospital
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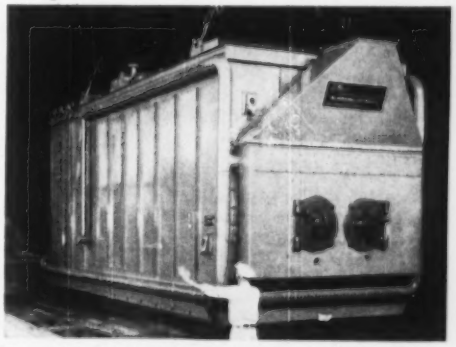
MISCELLANEOUS
New York International Airport, Idlewild

. . . that is the combined total hourly capacity of more than 75 International-LaMont Forced Recirculation Generators throughout the country—and the total is rapidly increasing as new units are placed into operation.

The economies of an HTW system (350°F. to 430°F.) over high pressure steam are significant . . . with International-LaMont Generators the savings are dramatic: 15-18% in installation . . . 15-20% in operation . . . 50-60% in maintenance.

Only International-LaMont Generators feature a built-in counterflow economizer which preheats return water and permits use of cost-cutting temperature differentials of up to 200°F.



International-LaMont Forced Recirculation Generators are available as package units up to 60,000,000 Btu/hr.

The inherent advantages of High Temperature Water for large area district heating systems have been found equally valuable for single building installations. The International-LaMont THERMOJET© series of forced recirculation generators are specifically designed for this type of application. Write today for Bulletins 700 and 1000.

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... economical duct liner adhesive

TUFF-BOND 21-C
... clear lap sealer and lap adhesive

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... exceptionally high-strength chemical-set adhesive with wide thermal range −100° F. to 400° F.

TUFF-BOND #1000
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... high pressure duct sealer

TUFF-BOND QUIK-SET
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Ask for descriptive literature and prices.

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DANVILLE 26, ILLINOIS

RECENT TRADE LITERATURE...

▸ *AIR COOLED CHILLERS*—Bulletin "8027A" describes, illustrates "ARPC" air cooled package chillers and "RCU" remote condensing unit assemblies. Included are capacity, component, dimensional data plus specification, wiring schematics. *Dunham-Bush, Inc., Dept. HPAC, 179 South St., West Hartford 10, Conn.*

▸ *AIR COOLED CONDENSER*—Diagrammed 24 page engineering manual deals with phases of selection, installation, operation, maintenance of company's line of "Zephyrcon" air cooled condensers. Included are tables, capacity charts, drawings of typical installations. *Larkin Coils Inc., Dept. HPAC, 519 Memorial Dr., S. E., P. O. Box 1699, Atlanta, Ga.*

▸ *BOILER FEED SYSTEMS*—Revised, expanded catalog covers manufacturer's entire line of boiler feeding systems, deaerating systems, feed pumps and accessories. Design developments covered in detail in illustrated catalog "55-C." *Fred H. Schaub Engineering Co., Dept. HPAC, 2110 S. Marshall Blvd., Chicago 23.*

▸ *CENTRAL STATION AIR CONDITIONING*—Illustrated 72 page catalog "39ACW = 55" for selection of central station air conditioning units for conventional and multizone applications. Conversion chart included provides two-step operation for figuring coil size; charts also available in larger size. Included are product features, mechanical specifications. Performance curves, rating tables for hot water, steam coils also provided. *Carrier Corp., Dept. HPAC, Carrier Pkwy., Syracuse 1, N. Y.*

▸ *CENTRIFUGAL FANS*—Two illustrated bulletins, "8414," "8314" describe line of centrifugal fan utility sets. Bulletin "8414" covers company's "HS" series, giving complete dimensions, specifications for each model. "Sirocco" series presented in bulletin "8314." Complete variety of sizes, styles—direct drive and v-belt drive outlined in text, pictures, charts, diagrams. *American Blower Div. of American-Standard, Dept. HPAC, Detroit 32.*

▸ *CENTRIFUGAL COMPRESSORS*—Illustrated 20 page bulletin "No. 909" details expanded line of centrifugal compressors. Bulletin describes construction, operating features, lists typical applications. Possible installations illustrated with photos, line drawings showing 24 positions for locating compressor discharge. Design features shown with cutaway photo, exploded view showing all components. *American-Standard, American Blower Div., Dept. HPAC, Detroit 32.*

▸ *CENTRIFUGAL REFRIGERATION*—Information on company's two-stage centrifugal refrigeration compressors given in 28 page bulletin. Features, specifications for evaporator and condenser and other equipment, instruments and safety controls, capacity control, purge systems, drives and auxiliary equipment all included. Illustrated throughout with data on dimensions, test facilities, applications. *Worthington Corp., Dept. HPAC, Harrison, N. J.*

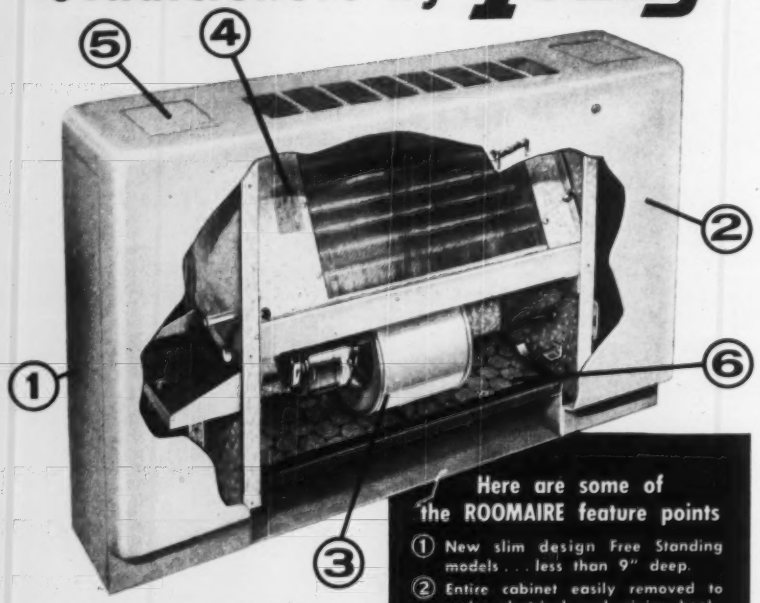
▸ *CONCRETE DRILL-ANCHORS*—Catalog on new "Bull dog Gold Digger" combination concrete drill and anchor provides information on double plating with installation-application data and complete specifications. Five types cataloged. Range of sizes: 3/16 to 7/8 in. *Polis Mfg. Co., Div. of Gregory Industries, Dept. HPAC, Toledo Ave. and E. 28th, Lorain, Ohio.*

▸ *COOLING COILS*—Recently published bulletin describes complete

Don't be your own worst enemy! If you notice one of cancer's danger signals in yourself, don't talk yourself into thinking it's nothing to worry about. See your doctor. Only **he** can tell. To learn the seven danger signals and to find out how to guard yourself against cancer, call our nearest office or just write to "Cancer," in care of your local post office.

AMERICAN CANCER SOCIETY

NEW THIN Remote Roomaire® Conditioners by Young

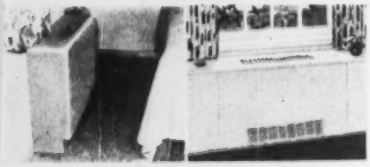


Here are some of the ROOMAIRE feature points

1. New slim design Free Standing models . . . less than 9" deep.
2. Entire cabinet easily removed to make electrical and piping hook-up. After unit is completely installed cabinet can then be put in place.
3. Multi-blade fan circulates air quietly and evenly. Fan and motor assembly easily removed and replaced in minutes.
4. High capacity cooling or heating coil is slanted for proper air flow and condensation drainage.
5. Four-speed motor switch permits finger-tip control for the desired volume of properly conditioned air.
6. Air filter changeable without removing front or any part of cabinet.

CHOOSE FROM 16 UNITS . . . 4 MODELS IN 4 SIZES

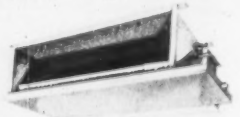
When you specify Remote Roomaire Conditioners by Young, you are providing year 'round comfort for individual rooms of multi-room installations. Both beauty and performance are combined in a quality unit by engineers known for their continuing research in air conditioning, heating and cooling. Available in four types and sizes, individually controlled Roomaire conditioners are ideal for use in office buildings, hotels, apartments, schools, and homes.



TYPE F (Free Standing) — Cabinets are less than 9" deep and only 25" high. Unit is very accessible for maintenance.

TYPE CF (Concealed Free Standing) — Designed for built-in installation directly below a window sill or back of a finished wall panel.

TYPE H (Horizontal) — Designed for exposed installation at ceiling.



TYPE CH (Concealed Horizontal) — For installation in a closet, or ceiling space.

For complete information see your nearest Young representative or write Young Radiator Co.

Young RADIATOR COMPANY
RACINE, WISCONSIN
Creative HEAT TRANSFER ENGINEERS
Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

Write Dept. 518-M for Catalog 7758

RECENT TRADE LITERATURE
Continued

line of "Herman Nelson" cooling coils. "Bulletin 880" contains coil selection information with descriptive information on coils. Included are photos, construction specifications, dimensional data, surface charts, circuiting diagrams. *American Air Filter Co., Inc., Dept. HPAC, Louisville 8.*

▸ *DEAERATING HEATER*—Illustrated 6 page bulletin has specifications, diagrams of manufacturer's "SSC" deaerating heater. Contains information on two-stage spray type packaged heater complete with internal vent condenser of stainless steel and all controls, valves in capacities 2800 lb per hr to 100,000 lb per hr. *Graver Water Conditioning Co., Dept. HPAC, 216 W. 14th St., New York 11.*

▸ *ELECTRIC HEATERS*—"GEC-10051" is designation of 52 page booklet presenting new heaters, devices available from manufacturer. New product information included on pipe heaters, thermostatically controlled immersion heaters, 1 in. diam water immersion heaters, new ratings, configurations of tubular heaters, many others. *General Electric Co., Dept. HPAC, Schenectady 5, N. Y.*

▸ *ESTIMATING CATALOG*—Illustrated 36 page pricing guide said to cover most of items normally used by contractors, engineers in heating, ventilation, air conditioning fields. Blowers, fans, coils, evaporative condensers, valves, fittings, etc. presented in tabular form. *M. Blazer & Son, Dept. HPAC, 173 Market St., Passaic, N. J.*

▸ *FEEDWATER EQUIPMENT*—Article entitled, "Feedwater Equipment Designs and Methods," discusses two main methods of treating boiler feedwater for industrial applications: hot process-hot zeolite and demineralization. Article is illus-

RECENT TRADE LITERATURE

Continued

trated with flow diagram and charts. *Graver Water Conditioning Co., Dept. HPAC, 216 W. 14th St., New York 11, N. Y.*

▸ *FEEDWATER SYSTEMS*—New specification sheet explains manufacturer's system is completely automatic generator installation. Makeup water fed automatically through compound leverage bronze mechanical float valve connected to external supply. Water level in boiler said to be held constant within ¾ in. variation. *Cyclotherm Div., National-U. S. Radiator Corp., Dept. HPAC, Oswego, N. Y.*

▸ *FLOW METERS*—Two catalog sheets, "CM-10" and "CM-12" describe "Model A5Y" industrial liquid flowmeter and "Model A4Y" gas flow meter. Both bulletins are 4 pages in length, illustrated with photos, diagrams and dimensional charts. Complete specifications given for both models. *Rotron Controls Corp., Dept. HPAC, Woodstock, N. Y.*

▸ *GALVANIZED SURFACE COATING*—New paint formulation developed for protection of galvanized surfaces regardless of condition described in "Red Lead Technical Letter No. 13." Paint has red lead-iron oxide-zinc dust pigmentation in alkyd resin vehicle. *Lead Industries Association, Dept. HPAC, 60 E. 42nd St., New York 17.*

▸ *HAND TORCHES*—New line of gas-fired, spear flame hand torches for brazing, soldering, glass ampoule sealing, spot heat treating, etc. presented in "Bulletin HT-1". Design features, dimensional data, construction details given in text, tables, illustrations. *Selas Corp. of America, Dept. HPAC, Dresher, Pa.*

▸ *HEATING-COOLING CATALOG*—Three-ring, looseleaf binder catalog presents manufacturer's line of heating and cooling products. Includes specifications for boilers, radiation, burners, cooling products. *American-Standard, Plumbing and Heating Div., Dept. HPAC, 40 W. 40th St., New York 18.*

▸ *HIGH VELOCITY AIR CONDITIONING*—New 24 page "Bulletin K 33-A" describes, illustrates complete line of "Series 45" high velocity valve attenuators. Technical and factual information on sound control, duct design methods, proper selection of units given with graphs, diagrams, charts. Separate scale drawings, photographs of five models given. *Dunham-Bush, Inc., Dept. HPAC, 179 South St., West Hartford 10, Conn.*

▸ *HUMIDITY CONTROL*—"Bulletin 1720, Target For Comfort" gives information on new automatic humidity control system. According to manufacturer, system puts end to "too cool" complaint against summer air conditioning. *Ranco Inc., Dept. HPAC, 601 W. Fifth Ave., Columbus 1, Ohio.*

▸ *INDUSTRIAL THERMOMETERS*—New, illustrated 8 page booklet describes company's complete line of stainless steel thermometers. The publication lists specifications, prices on over 100 angle form, straight form, special purpose thermometers available. *George A. Dillon, c/o W. C. Dillon & Co., Inc., Dept. HPAC, 14620 Keswick St., Van Nuys, Calif.*

▸ *METAL REPAIR*—"Devcon Products for Emergency and Maintenance Repairs" is title of new bulletin giving case histories to describe savings in time and money possible with product. "Plastic Steel" has been used in oil refineries, aircraft plants, municipal water departments, textile mills, natural gas plants, other industrial applications. *Devcon Corp., Dept. HPAC, Danvers, Mass.*

▸ *PIPE SUSPENSION*—"For the Life Streams of Your Building: The Whys, Whens, Wheres and Hows of

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where strength is needed ...at the threads

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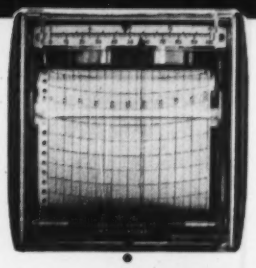

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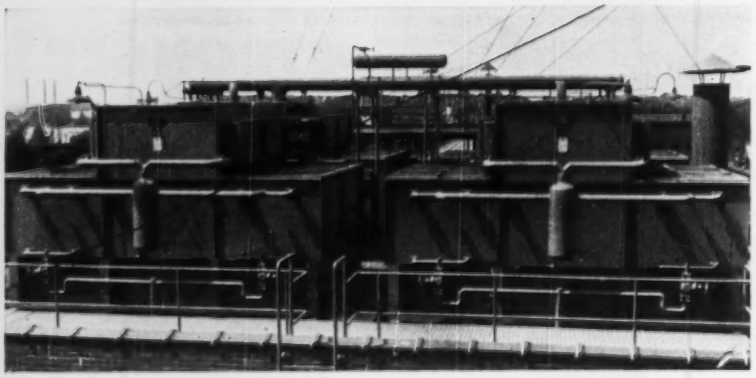

GET TROUBLE-FREE CONDENSING AND GREAT POWER AND LABOR SAVINGS

NIAGARA AEROPASS CONDENSERS give you trouble-free, automatic refrigeration at the least spread between head-pressure and suction pressure. You gain a great power saving. You also get removal of superheat before condensing, condensing at subcooled temperature and a refrigerant fully purged of oil. Out-door air takes up heat of condensation through evaporation of the least amount of water; low temperature condensing means freedom from scaling and loss of capacity. Niagara sectional design offers you lower costs for more compact equipment, easier to keep up. You get always full capacity, "new plant" efficiency and continuous savings such as 95% of condensing water cost that add to your profit. Managers who know their costs buy Niagara Aeropass Condensers.

Write for Bulletin 131

NIAGARA BLOWER COMPANY

Dept. HP-12, 405 Lexington Ave., New York 17, N.Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

RECENT TRADE LITERATURE

Continued

Pipe Suspension and Support" is long title of short book on pipe hangers and suspension equipment. Publication intended to promote understanding of problems and values in using such equipment among mechanical engineers, contractors, distributors. *Fee & Mason Mfg. Co., Inc., Dept. HPAC, Manasquan, N. J.*

▸ *PORTABLE X-RAY UNIT*—Bulletin describes "LX-140" portable X-ray unit, said to be lightest, most powerful for its weight. For pipe weld examination, unit can radiograph 1¼ in. of steel in 1½ min. *General Electric Co., X-Ray Div., Dept. HPAC, Milwaukee* 1.

▸ *PRESSURE DROP CHARTS*—Charts record results of physical tests on pressure drop conducted at Pratt Institute. Material also available in 1959 catalog which provides information on line of Y type and basket type strainers. *Mueller Steam Specialty Co., Dept. HPAC, 29 Masserole Ave., Brooklyn, N. Y.*

▸ *PROCESS PIPING EQUIPMENT*—Chemical processing is subject of 6 page color bulletin detailing equipment, services available from manufacturer. Among processes described in bulletin are ion exchange, sedimentation, filtration, flotation. Equipment for each is illustrated, described. *Graver Water Conditioning Co., Dept. HPAC, 216 W. 14th St., New York* 11.

▸ *RECEIVER-DRIER*—Catalog for 1958-1959 offers specifications, details of packaged refrigerants and receiver drier. Illustrated catalog also includes information on applications of mechanical, chemical refrigeration products. *Refrigeration Products Div., Ansul Chemical Co., Dept. HPAC, Marinette, Wis.*

▸ *SEAMLESS TUBING*—Technical folder explains simplification of production by selection of proper mechanical tubing. Illustrated with

RECENT TRADE LITERATURE
Continued

photos, drawings. *Babcock & Wilcox Co., Tubular Products Div., Dept. HPAC, Beaver Falls, Pa.*

▶ *STEAM METER*—"Accurate Steam Metering for 1—1½ in. lines" is title of 8 page bulletin describing features, operation, installation, specifications of "Model SMDH Style 57" meter. Publication illustrated with photos, cross-sectional views, dimensional drawings, capacity and accuracy tables. *Builders-Providence, Div., B-I-F Industries, Inc., Dept. HPAC, 345 Harris Ave., Providence, R. I.*

▶ *TIME SWITCHES*—"GEA-6681," new, illustrated 12 page bulletin describes "TS-40," "TS-41," "TS-47" time switches in text, pictures. Includes specifications, dimensions, design features, applications. *General Electric Co., Dept. HPAC, Schenectady 5, N. Y.*

▶ *TREATING PIPE FOR JOINING*—Bulletin describes "Oreco" process for cleaning copper and brass fittings. It is combination chemical bath and heat treatment which can be used on fittings to 8 in. diam. *O'Reilly Engineering Co., Dept. HPAC, 4924 W. Davis, Dallas 11, Tex.*

▶ *TUBING*—Wall-size, tabular bulletin gives physical and chemical characteristics of aluminum alloys and copper alloys in two tables. Manufacturer's products listed, illustrated with presentation of manufacturing processes. *Wolverine Tube, Div. of Calumet & Hecla, Inc., Dept. HPAC, 17200 Southfield Rd., Allen Park, Mich.*

▶ *WASTES TREATMENT* — Application engineering data sheet "D-58-1" describes continuous cyanide and chrome wastes treatment systems. Flow diagrams in 4 page brochure explain methods, equipment used to meter necessary chemicals automatically. *Milton Roy Co., Dept. HPAC, 1300 E. Mermaid Lane, Philadelphia.*

▶ *WATER CONDITIONING* — Fifth edition of company's handbook on industrial water conditioning recently published containing technical information on water treatment processes. Applications of water-treatment equipment covered. Section devoted to control water analyses, interpretation. $3.00. *Betz Laboratories, Inc., Dept. HPAC, Philadelphia 24.*

▶ *WATER CONTROL VALVES* — Valves, uses described in 8 page bulletin "G-5A." Covers cushioned check valves, water level control valves, sensitive pressure regulators, one-man control valves 2 to 36 in., pressures to 250 psi. *Golden-Anderson Valve Specialty Co., Dept. HPAC, 1210 Ridge Ave., Pittsburgh.*

▶ *WELDING FITTINGS, FLANGES*—"Technical Bulletin FDC-261" gives dimensions, diagrams of company's welding fittings, forged steel flanges in 4 in. nominal pipe size. Specifications given. *Babcock & Wilcox Co., Tubular Products Div., Dept. Hpac, Milwaukee.* ⊣

Major Oil Company SPECIFIED THERMAL

Two big Thermal central plant units were specified by a major oil company with headquarters in Houston for the year-round air conditioning of its Data Processing System. This same company has many other installations of Thermal air conditioning equipment in its several plants and office facilities.

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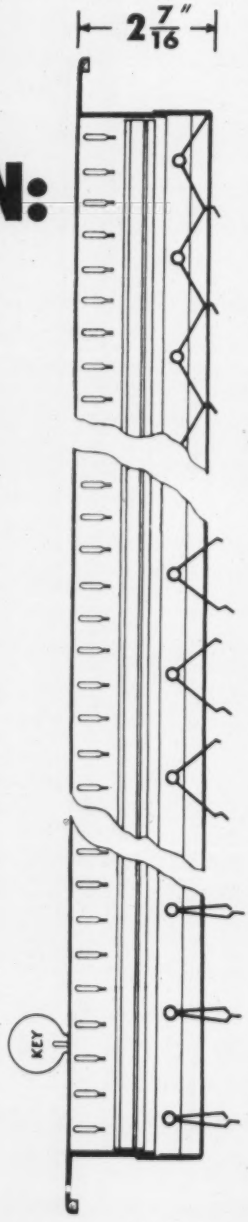
To find a commercial-type register with four way air-direction control plus volume control, that will work in standard 3¼" duct.

SOLUTION:



AIR CONTROL'S *Multi-Trol* Registers have exclusive **Shallo-Valve** – fit fine in 3¼" duct, leaving plenty of space for full air volume. And note how this patented butterfly valve action provides positive air volume control – assures even air distribution over register face at any setting. Seals *tight* when closed – can't whistle or rattle.

Ideal for both heating and cooling in commercial and de-luxe residential installations, Air Control's *Multi-Trol* registers feature fully adjustable face bars for 2-way or 4-way control of air pattern. Bars have air foil shape and are locked to side margins – can't come loose. Complete range of style and sizes. Attractive beige prime coat.

FREE '58 CATALOG SHOWING COMPLETE AIR CONTROL LINE — SEE YOUR JOBBER OR WRITE US.

AIR CONTROL PRODUCTS, Inc.
358 Center St., Coopersville, Michigan

WHO'S WHAT . . .

(New personnel, promotions)

▸ *CERRO de PASCO CORP.*—Richard H. Lewin, president of *LEWIN-MATHES CO. DIV.*

▸ *ARKLA AIR CONDITIONING CORP.*—Chester L. May, elected chairman of board of directors.

▸ *WESTINGHOUSE ELECTRIC CORP.*—Bruce D. Henderson, vice president, assigned to staff of executive vice president; Raymond K. Serfass, manager of air conditioning division.

▸ *CRANE CO.*—Norman F. Garrett, vice president and general manager for manufacturing; Walter Kovalick, assistant general manager of Chicago manufacturing division.

▸ *GREGORY INDUSTRIES, INC.*—Leonard C. Barr, executive vice president; Richard E. McGinnis, vice president—sales; George E. Gregory, Jr., vice president and treasurer; Robert J. Kilmer, vice president—trade relations.

▸ *JOSAM MFG. CO.*—J. S. Newman, executive vice president and general manager.

▸ *RAWLPLUG CO., INC.*—Allerton J. McEwan, vice president—sales.

▸ *YORK CORP.*—Emil Peslar, vice president and general works manager of Grantley Works; S. S. Meadows, vice president and general manager of Decatur operations.

▸ *McQUAY, INC.*—G. G. Workinger and Henry B. Williams, vice presidents.

▸ *JOHNSON SERVICE CO.*—Joe Wheeler, Jr., vice president; H. W. Alyea, director of engineering; W. P. Chapman, director of research and development; John C. Spangler, director of manufacturing.

▸ *SOUTHERN CLAY PIPE INSTITUTE*—Lewis A. Young, secretary-manager.

WHO'S WHAT

Continued

▶ *W-K-M, DIV. of ACF INDUSTRIES, INC.*—M. R. Chance, chief metallurgist.

▶ *LESLIE WELDING CO., INC.*—Donald L. Rousey, chief engineer.

▶ *WATERMAN-WATERBURY CO.*—F. W. Legler, general manager of *WATERBURY CO.* sales organization.

▶ *DUDLEY DEANE AND ASSOCIATES*—Louis O. Britt, general manager; Donald R. Lundy, chief mechanical engineer.

▶ *UNITED STATES DEPT. OF COMMERCE*—Dr. Robert D. Huntoon, deputy director of *NATIONAL BUREAU OF STANDARDS.*

▶ *ROBERTSHAW-FULTON CONTROLS CO.*—Charles A. Bogenrief, director of facilities and tooling.

▶ *HANDY & HARMAN*—E. Earle Tietz, manager of marketing services; Robert E. Burke, field sales manager.

▶ *DRAVO CORP.*—D. R. Berg, new product development department manager.

▶ *UNION CARBIDE CHEMICALS CO.*—Thomas M. Hartley, sales manager for "Ucon" refrigerants.

▶ *WARREN BARR SUPPLY CO.*—Charles R. Bennett, manager of heating and air conditioning department.

▶ *RANCO INC.*—Robert S. Raney, marketing manager.

▶ *RAMSET FASTENING SYSTEM, OLIN MATHIESON CHEMICAL CORP.*—R. H. Benedict, Jr., field sales manager; A. T. Masters, manager of product evaluation; Donald Binder, purchasing agent; Edward Nimtz, customer service manager in sales department.

FOR SIMPLIFIED INSTALLATION AND COMFORTABLE ROOM HEAT

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Cut-open view of Model A Panel-Vector

Shaw Panel-Vectors are of rigid, fully-integrated construction, delivered ready to install. There are no dampers or separate housings to fit and hang. Choice of same end or opposite end tapping offers opportunities for important piping simplification and economies.

Panel-Vectors distribute a *low-temperature*, unvarying combination of radiant and convected heat that only Nature—at her best—can rival. Stratification, and areas of extreme heat or chill are eliminated . . . room occupants are not only warm, they are *comfortably* warm.

Shaw Panel-Vectors use hot water or steam up to 150 psi. They are available in wall-hung (panel) or baseboard models, each a space-saving 3" deep. There is a full range of sizes to meet any room-heat distribution requirement.

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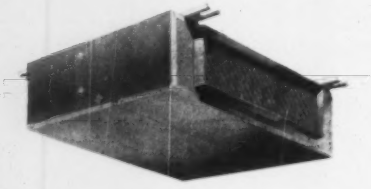
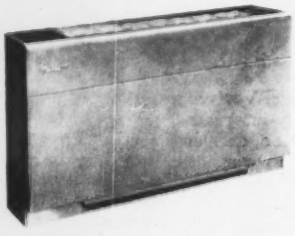
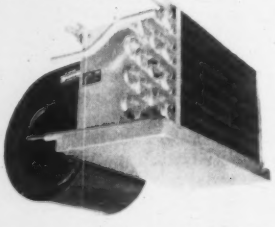


LRC's . . . basic unit, concealed or deluxe cabinet (200 thru 600 cfm)



VRC's . . . concealed or deluxe consoles (200 thru 600 cfm)



HRC's . . . three suspended types (300 thru 1750 cfm)

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WHO'S WHAT

Continued

▸ *COBELL INDUSTRIES INC.*— George Lucas, national sales manager.

▸ *COMBUSTION ENGINFERING, INC.*—James M. Cowell, Jr., director of purchases.

▸ *AMERICAN-STANDARD*—Robert L. Livingston, personnel administrator in research department of Plumbing and Heating Div.

▸ *OIL-HEAT INSTITUTE OF AMERICA, INC.*—Larry D. Sibley, vice president of combustion control division of Electronics Corp. of America, appointed chairman of Commercial-Industrial Accessory Section; J. W. Cowan, vice president of Ace Engineering Co., chairman of Commercial-Industrial Manufacturer Section; C. H. Pesterfield, chairman of ASHAE Guide publication committee and education committee; Jack Kaplan, Preferred Utilities Mfg. Co., chairman of air pollution committee; Richard Wright, Iron Fireman Mfg. Co., chairman of engineering committee; W. H. Bohn, Preferred Utilities Mfg. Co., chairman of membership committee; R. C. Westover, Ray Oil Burner Co., chairman of program committee; George E. Lind, Combustion Control Div., Electronics Corp. of America, chairman of Springfield Trade High School steering committee; D. H. Bottrill, technical secretary, to act as liaison for Springfield Trade High School steering committee.

▸ *WOLVERINE TUBE, DIV. OF CALUMET & HECLA*—Lloyd G. Fox, manager of product sales, vice chairman in pipe and tube section of Copper and Brass Research Association.

▸ *CONTROLS CO. OF AMERICA*—Jack Searls, manager of field sales, heating and air conditioning controls.

▸ *AMERICAN RADIATOR & STANDARD SANITARY CORP.*—Howard L. Spindler, vice president, elected president of Plumbing-Heating-Cooling Information Bureau.

▸ *CHRYSLER CORP., AIRTEMP DIV.*—Marvin B. Smith, director of production programming and procurement.

▸ *AUER REGISTER CO.*—George W. Hoagland, manager of manufacturing.

WHO'S WHAT *Continued*

IN THE TERRITORIES . . .

(Recent sales appointments)

▸ *ARMCO STEEL CORP.*—F. A. Tobitt, Jr., district sales manager of Indianapolis office; C. W. Azbell, district manager of Columbus office; C. L. Hill, district manager of Louisville office.

▸ *TACO HEATERS, INC.*—William P. Haney, Chicago district sales and service manager; Vincent F. Callahan, New England district sales manager.

▸ *CLAYTON MARK & CO.*—Walter A. Gustafson, sales representative in New England states; Richard J. Young, sales representative in mid-Atlantic states.

▸ *COBELL INDUSTRIES, INC.*—Project Development Engineers, Pensacola, Fla., sales representative.

▸ *AMERICAN-STANDARD, PLUMBING AND HEATING DIV.*—Thomas F. Brady, Pacific sales district manager; Donald E. Sander, south central sales district manager; Roy O. Lovell, Jr., New Orleans office manager; Dale W. Pearson, San Francisco office manager.

▸ *GENERAL CONTROLS CO.*—Fred E. Weldon, vice president in charge of eastern sales.

▸ *AIR-MAZE CORP.*—McMurry & Co., Miami, and H. L. McMurry & Co., Jacksonville, Fla., sales representatives.

▸ *LIMA REGISTER CO.*—Claude Wilson, district manager for Colorado, Utah, Kansas, Nebraska, Kansas City and St. Joseph, Mo.: Otis N. Fussell, district sales representative for Tennessee, Arkansas, Louisiana, Mississippi, Alabama; J. P. Ashcraft Co., Inc., Dallas, manufacturer's sales and warehousing representative for north Texas and Oklahoma area.

▸ *COPELAND REFRIGERATION CORP.*—M & M Refrigeration Supply Co., El Paso, Tex., authorized stocking wholesaler for area. Polar Supply Co., Peoria, Ill., authorized stocking wholesaler; United States Electric Co., Springfield, Ill., authorized stocking wholesaler.

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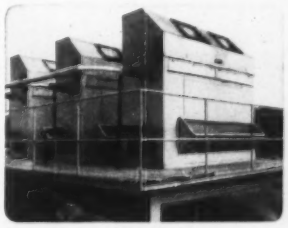
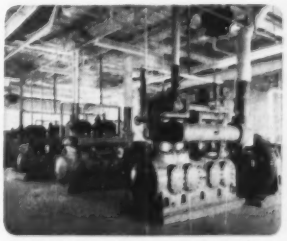


Frick Evaporative Condensers Save Up to 95% of the Water Used.



Frick Heavy-Duty Four Cylinder Compressors Can Be Adapted to Handle Any Type of Refrigerant.

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It is a proven fact that today's semi- and full-automatic equipment soon saves enough to pay for itself.

Whatever the refrigeration requirements of your plant—quick freezing, ice making, cold storage, humidity control, low temperatures, condensing, air conditioning, or any process cooling . . . Frick engineers will help you modernize your present system or design one to meet your needs.

Frick refrigeration equipment is world renowned for a long trouble-free life of dependable operation. Many Frick compressors have been in operation for over 40 years.

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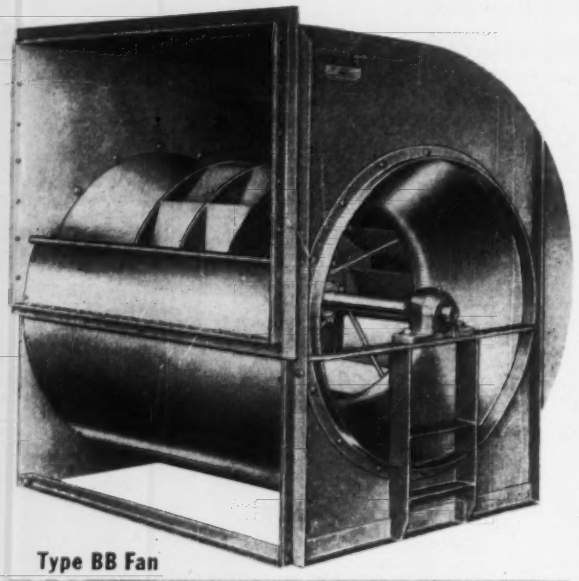
WAYNESBORO, PENNA., U. S. A.



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CERTIFIED
PERFORMANCE

ALADDIN Type BB Fans are the first choice of many engineers for heating, ventilating and air conditioning jobs. Designed for low rotational speeds and high efficiency, these fans insure that stable performance from free delivery to shutoff that engineers have come to expect of this type of equipment.

In designing the BB Fan, Aladdin engineers have refused to short-cut quality, each fan is ruggedly built and is backed by thirty-five years of experience and manufacturing know-how.

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WHO'S WHAT *Continued*

▸ *TRANE CO.*—George Karman, Jr., sales engineer in Baltimore sales office.

▸ *DUNHAM-BUSH, INC.*—Patrick J. Shea, district manager for Los Angeles office; Harry R. Brooks, salesman, St. Louis; Thomas L. Joliat, application engineer, Detroit; Thomas Walsh, application engineer, northeast district office; Lawrence Kohlberg, heating products salesman, St. Louis; Frank S. Robinson, salesman, Dallas; Clyde C. Dollens, industrial salesman, southwest district; John Charles English, application engineer, Detroit; Thomas Cantflin, salesman, Akron, Ohio; J. T. Golitz, salesman, Providence, R. I.-Worcester, Mass. area; David Dufur, salesman, Portland, Ore., territory.

▸ *DRAVO CORP.*—Joiner-Meade-Capers, Inc., Dallas, manufacturers representative in 75 Texas counties; Houston Co., Lubbock, manufacturers representative in 68 Texas counties and five New Mexico counties; A. F. McGovern & Son, manufacturers representative in 22 Ohio counties; A. Y. McDonald Mfg. Co., Minneapolis, manufacturers representative in South Dakota, Minnesota and 15 counties in Wisconsin.

▸ *EMBASSY STEEL PRODUCTS, INC.*—Stuart Davis & Co., Royal Oak, Mich., sales representatives for Michigan area.

▸ *CONNOR ENGINEERING CORP.*—Air Conditioning Supply Co., Los Angeles, manufacturers representative for Los Angeles and San Diego area.

▸ *SOLAR AIRCRAFT CO.*—Pan American Western Co., Inc., Coral Gables, Florida area representative.

▸ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—R. B. Grant, Rocky Mountain region manager; J. T. Pitts, southwest region manager; E. A. Thompson, special sales representative in Los Angeles; R. L. Mallory, sales manager of industrial products group in Philadelphia.

▸ *WESTCOTT SNYDER MFG. CORP.*—Samuel S. Neide & Associates, Gaithersburg, Md., factory representatives in middle Atlantic states area.

▸ *EUTECTIC WELDING ALLOYS CORP.*—E. W. Sales & Welding Service, Inc., Chicago, incorporated into sales organization as Eutectic Welding Alloys—Central Div., Inc.

WHO'S WHAT *Continued*

▶ *AMERICAN-STANDARD*—James M. Martin, St. Louis sales manager for *PLUMBING AND HEATING DIV.*; J. A. McCain, eastern regional manager; R. C. Wilts, New York branch manager; H. B. Barron, eastern regional manager, power plant equipment; all for *AMERICAN BLOWER DIV.*

▶ *KEASBEY & MATTISON CO.*—John L. Prechek, assistant manager of San Francisco district.

▶ *GRAVER WATER CONDITIONING CO.*—G. M. Wallace & Co., engineering representatives in Rocky Mountain — intermountain area, with offices in Denver, Butte, Mont., Salt Lake City and El Paso, Tex.

▶ *COCHRANE CORP.*—Exclusive representatives in Rocky Mountain area: Hank Thurstin Co., Denver; C. H. Spencer & Co., Salt Lake City; S. C. Covington, Inc., Amarillo; Associated Engineers, El Paso, Tex.

▶ *ADVANCE INDUSTRIES, INC.*—Whitney M. Kerr Co., Kansas City area sales representative; J. C. McDougall Co., Seattle sales representative. ‡

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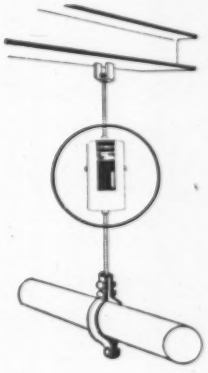
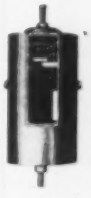


- Rugged
- Compact
- Simple in design and installation
- Indispensable for systems operating at changing temperatures

FIG. 401
SPRING HANGER



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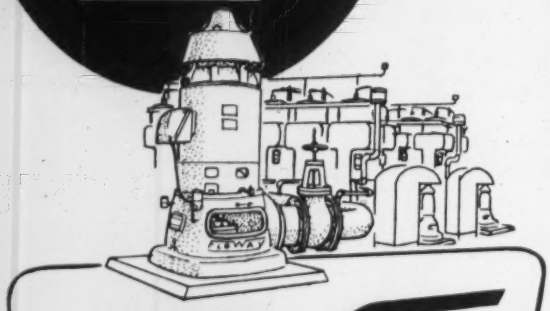

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FIESE & FIRSTENBERGER PUMPS FRESNO, CALIF.

WE HEAR THAT...

▸ A new office-warehouse has been opened by *POWERS REGULATOR CO.* at 4556-60 Lenox Ave., Jacksonville, Fla.

▸ A new sound film on manufacturing of package boilers recently released by *CYCLOTHERM DIV., NATIONAL-U. S. RADIATOR CORP.*, was shown at the Connecticut Light and Power Gas Show on October 21-23.

▸ *ALUMINUM CO. OF AMERICA* plans to build a new facility for the production of roller-coated aluminum sheets in widths exceeding any previously available. The new unit is to be constructed adjacent to the company's North Plant sheet mill at Alcoa, Tenn.

▸ Two five-day courses marked the final sessions of the *AMERICAN-STANDARD* heating-cooling school in Buffalo, N. Y., for 1958. The final program included: basic radiator heating school, December 1-5; and "Remotaire" systems school, December 8-12.

▸ A new $6½ million plant for the manufacture of cast iron pressure pipe was opened October 22 by *JAMES B. CLOW & SONS, INC.* The new plant, which is the corporation's third pipe manufacturing works, contains more than 100,000 sq ft of inclosed floor space and occupies a 60 acre site in Bensenville, Ill.

▸ An agreement by *GENERAL CONTROLS CO.* to purchase the assets of *FOSTER ENGINEERING CO.* has been announced. The purchase is subject to the approval of the stockholders of the former company.

▸ *OHIO INJECTOR CO.* has been awarded a contract by the Atomic Energy Commission for the development of a device for controlling the sodium coolant in fast breeder power reactors. The project, involving a wide scope of activities ranging from studies of materials suited to handling high temperature sodium to building and testing prototypes, is expected to require a year in its first phase.

▸ *CONTROLS CO. OF AMERICA* was featured on a recent Milwaukee telecast in a Sunday afternoon series, "Challenge," offered on station WISN-TV. The new series is being produced in cooperation with industrial firms of the Milwaukee area and the Milwaukee School of Engineering and it highlights careers in engineering for young people in the Milwaukee area. In their telecast, *CONTROLS CO. OF AMERICA* spokesmen pointed out the outstanding career opportunities for young engineers in the mushrooming controls field.

WE HEAR THAT

Continued

▸ *DOVER MFG. CO.* and *J. F. PRITCHARD CO. OF CALIF.* recently merged. The composite company, operating under the Pritchard name, will maintain administration headquarters at the latter company's offices at 4625 Roanoke Pkwy., Kansas City, Mo.

▸ The Campbell Plant of *YOUNGSTOWN SHEET AND TUBE CO.* will be revamped in a two year program that will cost in excess of $50 million. The improvement will enable the mill to roll larger diameter coils of up to 40,000 lb.

▸ *WALTER E. WATSON,* vice chairman of *YOUNGSTOWN SHEET AND TUBE CO.* has announced his retirement after 45 years of sales service.

▸ A college scholarship program for sons and daughters of employees of *SARCO CO., INC.* and *SARCOTHERM CONTROLS, INC.* has been announced by the two affiliated companies.

▸ A *WARREN WEBSTER & CO.* sales group will attend a two day meeting at Cherry Hill Inn, near the company's Camden, N. J. headquarters.

▸ *HOWARD INDUSTRIES, INC.* has purchased a complete line of precision-type motors from *McGRAW-EDISON CO.* The purchase includes the complete line of motors, tools, jigs, dies, fixtures, engineering and inventory.

▸ A $1,600,000 contract calling for the construction of a modern rubber factory in Springfield, Mo. has been awarded to Kretzer-McLean Construction Corp. by *DAYTON RUBBER CO.*

▸ The Chicago regional office of *DETROIT CONTROLS DIV. of AMERICAN-STANDARD* has moved into larger quarters at Mannheim Rd. and North Ave. in Melrose Park. The new office and warehouse contains over 4000 sq ft.

▸ *WALWORTH CO.* has established its central division headquarters and distribution center in a new building at Glenshaw, a suburb of Pittsburgh. The one story, aluminum clad building has floor area of 55,000 sq ft. The *RUST ENGINEERING CO.* was the architect and contractor for the structure.

▸ *DRAYER-HANSON, DIV. of NATIONAL-U. S. RADIATOR CORP.* will hold its national sales meetings in Philadelphia, January 26-29, 1959, in con-

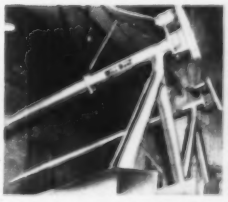
Coal *has always been dependable* now it can be automatic

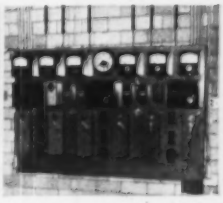
Will-Burt Hopper and Bin Feed Model Stokers — capacities, 150 through 750 lbs. per hr.

A Will-Burt coal heat installation will *bring coal from bin to stoker . . . feed the necessary coal at any of three adjustable rates . . . and automatically adjust air supply minute by minute, to fuel bed needs.* Panel controls by Will-Burt will *automatically cycle one stoker, or several.*

What could be more practical — especially when you consider the known economy and safety of coal fired heat?

Air Controlled WILL-BURT STOKER





WILL-BURT STOKERS
Box 902 ORRVILLE, OHIO

W-B Automatic Air Control — sensitively controls air supply — prevents excessive soot or smoke.

W-B Coal Conveyor — practical for any installation — operates at any angle — single, dual, or cross feed tandem.

W-B Panel Controls — make scheduled heating a simplified, supervisory operation — tailored to the job.

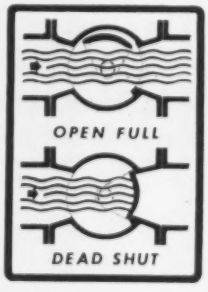
THERE'S NO MAGIC in a DeZurik Valve.. it just SEEMS that way!

DeZurik Valves have so many advantages over ordinary valves it may seem too good to be true. They open easily . . . close tight . . . open or close with a quarter-turn . . . need no lubrication . . . never freeze!

What accounts for this seeming magic?

ECCENTRIC ACTION

This principle, exclusively DeZurik's, permits the plug to touch the valve body *only* when the valve is closed. The resilient plug-facing seals tight every time on any line. Opening the valve backs the plug away from the seat and the plug swings open easily . . . without friction . . . without lubrication!



DeZurik Valves are available in a full range of models and metals and in sizes from ½" thru 20" with lever, gear, or remote operation. See the DeZurik representative in your area, or write for details.

DeZURIK CORPORATION
SARTELL, MINNESOTA

WE HEAR THAT — *Continued*

junction with the 14th International Heating & Air Conditioning Exposition.

▶ *MASON PRODUCTS, INC.* has moved from West Concord, Mass., to a new plant at 9 Cranes Court, Woburn, Mass.

▶ The new headquarters building and research center of *HAGAN CHEMICALS & CONTROLS, INC.* are situated on a 27 acre site along the Penn-Lincoln Parkway West, 12 miles from downtown Pittsburgh. The 60,000 sq ft main building houses the executive offices, sales division offices and the purchasing, engineering design, accounting and advertising departments. The adjacent 33,000 sq ft research center contains laboratory facilities, chemical research groups, and a scientific library.

▶ *W. A. ROOSEVELT CO.* celebrated its 90th anniversary during October. *J. M. BRINDLEY*, president of the La Crosse, Wis., wholesaler of heating, piping and air conditioning equipment, is a grandson of the company's founder, *W. A. ROOSEVELT*.

▶ Operations of the *PASOL ENGINEERING CO.* have been merged into *GALLAHER CO.* It became a division of the parent company on December 1.

▶ *GREENHECK FAN & VENTILATOR CORP.* has been approved for membership in *AIR MOVING AND CONDITIONING ASSOCIATION*.

▶ Construction of the *AMMERMAN CO.'s* new manufacturing plant at Stillwater, Minn., is well under way. Completion of the 30,000 sq ft, single story building is expected this month, when the company's equipment will be moved to its new quarters from its present location in Minneapolis.

▶ *CLEAVER-BROOKS CO.* has acquired *SPRINGFIELD BOILER CO.* The transaction calls for the investment of $1 million by the purchasing company: $500,000 for the purchase of the business with an additional $500,000 to cover working capital requirements.

▶ The new plant of *U. S. GAUGE DIV. of AMERICAN MACHINE AND METALS, INC.* at Sellersville, Pa., was open for plant tours on two days during the month of November. For November 21, invitations were issued to industrial and civic leaders, magazine and newspaper editors. November 22 was set as "Employees Day." ∓

MEETINGS & CONVENTIONS

1958

DEC. 8-10—*American Nuclear Society*, 1958 annual meeting. Sheraton-Cadillac Hotel, Detroit. National headquarters: American Nuclear Society, Chicago 1.

1959

JAN. 14-15—*Building Research Institute*, conference on noise control in buildings. Hotel New Yorker, New York City. Building Research Institute, National Academy of Sciences—National Research Council, 2101 Constitution Ave., Washington 25, D.C.

JAN. 19-20—*Industrial Heating Equipment Association, Inc.*, meeting. Cleveland, Ohio. IHEA headquarters: 1145 19th, N.W., Washington 6, D. C.

JAN. 26-29—*14th International Heating and Air Conditioning Exposition*. Philadelphia. Under auspices of the American Society of Heating and Air-Conditioning Engineers, in conjunction with its 65th annual meeting, also in Philadelphia. Exposition management: International Exposition Co., 480 Lexington Ave., New York 17. ASHAE headquarters: 62 Worth St., New York 13.

JAN. 26-29—*Plant Maintenance and Engineering Show and Conference*, Cleveland Public Auditorium, Cleveland, Ohio. For information, contact: Clapp & Poliak, Inc., 341 Madison Ave., New York 17.

FEB. 3-5—*Society of the Plastics Industry, Inc.*, 14th SPI reinforced plastics division conference. Edgewater Beach Hotel, Chicago. SPI headquarters: 250 Park Ave., New York 17.

FEB. 16-19—*Industrial Ventilation Conference*, eighth annual meeting. Kellogg Center for Continuing Education, Michigan State University, East Lansing, Mich.

MARCH 16-20—*National Association of Corrosion Engineers*, 1959 Corrosion Show and 15th annual conference. Sherman Hotel, Chicago. National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

MARCH 31-*APRIL* 2—*American Power Conference*, sponsored by Illinois Institute of Technology in cooperation with a group of technical societies and

the downturn

and upturn at KVP

Same picture – different setting. Top shows complicated, space-wasting duct system which routed fumes back into plant for discharge through stacks. Bottom shows nine new 36" Aerovent "SP-7" Duct Fans installed to take fumes *up* and *out*, saving valuable floor space in busy working area. Just one of hundreds of successful Aerovent installations characterizing modern air engineering in action.

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All Aerovent Fans are rated in accordance with the Standard Test Code and U.S.D.C. Comm. Std. CS178-51.

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It's the ... Sterlco®
THERMOTROL
for ACCURATE, INDEPENDENT ROOM TEMPERATURE CONTROL

STEAM or HOT WATER SYSTEMS
... for modernization or new construction

CAN BE KEY LOCKED

for ...
HOSPITALS, APARTMENTS, OFFICES, HOTELS, SCHOOLS, MOTELS, INSTITUTIONS and PUBLIC BUILDINGS

- **COMPLETELY SELF-CONTAINED**
  Each Sterlco Thermotrol is a complete temperature control unit, easily installed in any two-pipe system in place of the manual valve. NO wiring or other external connections needed.
- **MODULATING CONTROL—NOT on AND off**
  Each Sterlco Thermotrol provides steady, even control to each radiator the way YOU want it. Radiators in cold spots give off heat while those in warmer parts of the same room are automatically throttled down.
- **NO ELECTRICAL CONNECTIONS**
  No electric wiring, additional piping, or other connections are required with the Sterlco Thermotrol. Just as easily installed for modernization as for new construction.

FOR BUILDING MODERNIZATION
With a Sterlco Thermotrol on each radiator, stuffy overheated rooms, open windows, and excessive fuel bills are eliminated. You pay for only the heat you need ... rooms are comfortably, evenly warm ... occupants comfortable.

FOR NEW CONSTRUCTION
Here's modern ZONE CONTROL for radiant systems. The only modern solution to inefficient "on-off" valves and expensive, motorized valves.

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Sterlco Products Distributed through
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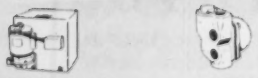

CONDENSATION AND VACUUM PUMPS | HEATING SPECIALTIES | TEMPERATURE CONTROLS

MEETINGS & CONVENTIONS *Continued*

1959

other educational institutions. Hotel Sherman, Chicago. Information: R. A. Budenholzer, Mechanical Engineering Dept., Illinois Institute of Technology, 3300 Federal St., Chicago 16.

APRIL 1-3—*Gas Appliance Manufacturers Association*, annual meeting. The Greenbrier, White Sulphur Springs, W. Va. GAMA headquarters: 60 E. 42nd St., New York 17.

APRIL 5-9—*Nuclear Congress*. Cleveland Auditorium, Cleveland. Information: Engineers Joint Council, 29 W. 39th St., New York 18.

APRIL 5-9—*Edison Electric Institute*, annual convention, New Orleans. Edison Electric Institute, 420 Lexington Ave., New York 17.

APRIL 6-8—*Building Research Institute*, eighth annual meeting. Hotel New Yorker, New York City. Building Research Institute, National Academy of Sciences—National Research Council, 2101 Constitution Ave., Washington 25.

APRIL 6-10—*International Atomic Exposition*, sponsored by Atomic Industrial Forum, Inc., Cleveland. Information: H. F. Grebe, exhibits manager, International Atomic Exposition, Architects Bldg., Philadelphia 3.

APRIL 28-*MAY* 1—*Mechanical Contractors Association of America*, 70th annual convention. Shoreham Hotel, Washington, D. C. MCAA headquarters: 45 Rockefeller Plaza, Suite 570, New York 20.

APRIL 29-*MAY* 4—*Oil-Heat Institute of America, Inc.*, annual convention. Seattle, Wash. Oil-Heat Institute of America, Inc., 500 Fifth Ave., New York 36.

MAY 17-20—*Industrial Heating Equipment Association*, meeting. The Homestead, Hot Springs, Va. Industrial Heating Equipment Association, Inc., 1145 19th, N. Y. Washington 6, D. C.

MAY 25-29—*National Fire Protection Association*, annual meeting, Atlantic City, N. J. National Fire Protection Association, 60 Batterymarch St., Boston, Mass.

MEETINGS & CONVENTIONS

Continued

1959

JUNE 7-11—*American Society of Heating and Air-Conditioning Engineers*, semi-annual meeting. Vancouver, B. C., Can. ASHAE headquarters: 62 Worth St., New York 13.

JUNE 21-26—*American Society for Testing Materials*, annual meeting. Chalfonte-Haddon Hall, Atlantic City, N. J. ASME headquarters: 1916 Race St., Philadelphia 3.

JUNE 22-24—*American Society of Refrigerating Engineers*, annual meeting. Lake Placid Club, Lake Placid, N. Y., ASRE headquarters: 234 Fifth Ave., New York 1.

SEPT. 21-25—*Instrument Society of America*, instrument-automation conference and exhibit. International Amphitheater, Chicago. For information contact: Fred J. Tabery, exhibit manager, Instrument-Automation Conference and Exhibit, 3443 S. Hill St., Los Angeles 7.

NOW is the time to consider

SNOW MELTING

Systems around Buildings and Grounds

Better send at once for our SNOW MELTING MANUAL. Here are design data based on a study of—and others' actual experience with over 100 snow melting systems of all kinds for

- LOADING PLATFORMS and DOCKS
- SIDEWALKS • ROADS • DRIVEWAYS
- MARQUEES • PARKING AREAS
- RUNWAYS • RAILWAY SWITCHES

and other applications which HAVE proved that this modern method of snow removal.

Costs No More Than Other Methods

—and because snow melting by pipe coils has other distinct advantages, such as dirt-free sidewalks and entrances, and the complete elimination of ice surfaces, the demand for this method of snow removal is swiftly growing.

Complete information on the correct design, installation and operation of snow melting systems is offered in the new SNOW MELTING MANUAL, a reprint of articles originally published in HEATING, PIPING & AIR CONDITIONING. Fifty cents per copy.

$0.50 will bring you this SNOW MELTING MANUAL . . . a valuable addition to your file on business opportunities.

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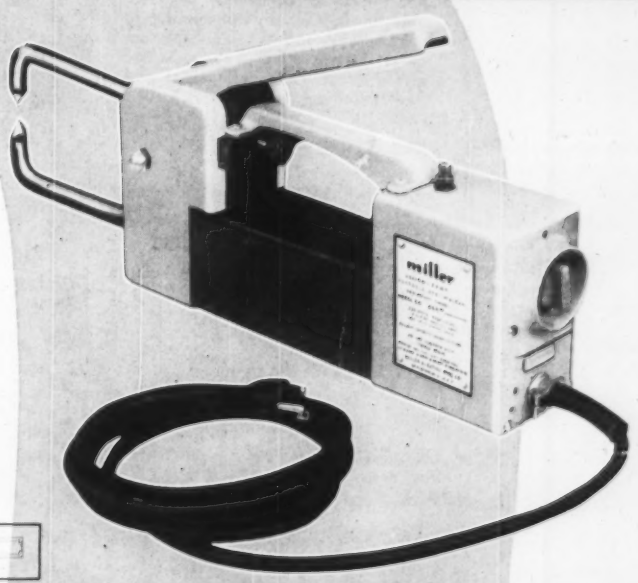
THE NEW MILLER ALL-IN-ONE SPOT WELDER for ALL NUMBER ONE WELDS

LECTRO SPOT



Built-in Timer Turns the Trick

Sheet metal shops ready for new speed, economy and completely uniform spot welds will want the new Lectro Spot. Here's why:

Operator depresses lever and,
1 — 2 — 3:
Tongs grip work at pre-set pressure;
Starter switch is actuated;
Weld sequence starts and stops automatically;
Result: EVERY WELD IS IDENTICAL!

Pressure adjustment and electronic timer controls instantly accessible.

Three models in 115 or 230 volts weld mild steel of 1/8" to 3/16" combined thickness; 1.5 KVA weighs 29 lbs., 2.5 KVA weighs 39 lbs.

Wide choice of tongs available.

Complete information sent promptly.

miller ELECTRIC MANUFACTURING COMPANY, INC. Appleton • Wisconsin

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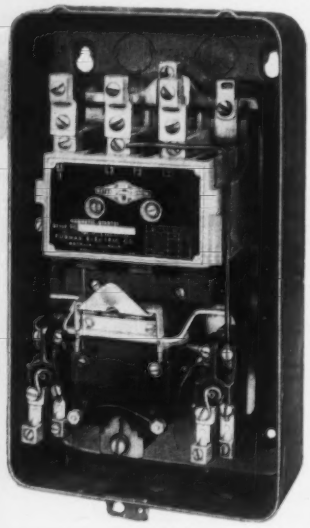
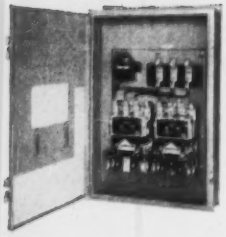
FURNAS ELECTRIC

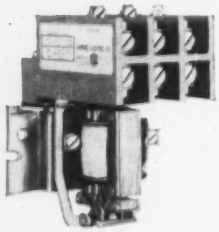
CONTROLS HELP YOU REDUCE COST AND SPACE REQUIREMENTS



Magnetic Starters in 10 sizes to 100 hp. Furnas starters for control of high horsepower compressors offer the exclusive Furnas "in-between" size starters with dual voltage magnet coils.



Step or Cushion Starting permits the use of larger motors by limiting the inrush current on starting. These methods reduce or completely eliminate objectionable line disturbances due to full voltage across-the-line starting. Furnas Electric offers a complete line of Increment, Auto Transformer and Resistance-type Step Starters.



Furnas contactors feature 20, 24, 30, 35, 40, and 50 ampere sizes to match starter requirements. Silver cadmium oxide contacts for longer life. Floating armature insures quiet operation.

For full information write for Bulletin 5610, 1041 McKee St., Batavia, Ill.

A42

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SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

NEW BOOKS & REPORTS...

ENGINEERING AND TECHNICAL CONVENTIONS—Prepared by Deutsch and Shea, Inc. Industrial Relations News, 230 W. 41st St., New York 36. Subscriptions $4.00 per year, including annual Fall Supplement.

FUNDAMENTALS OF PIPE DRAFTING—By Charles H. Thompson. 66 pp. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. $3.50.

STANDARD WELDING SYMBOLS. Dept T, American Welding Society, 33 W. 39th St., New York 18. Charts, $1.50 and 50c; booklet, $3.00.

THE RESULTS APPROACH TO ORGANIZATION—By Edward C. Schleh. Research Div., Society for Advancement of Management, 74 Fifth Ave., New York 11. $1.50.

TEST AND EVALUATION OF THE MA-5 AIR CONDITIONER—By J. L. Hahn and D. J. Scarafile. 29 pp. Office of Technical Services, U. S. Department of Commerce, Washington 25. $1.00.

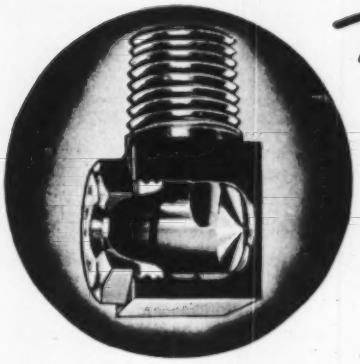
WELDOR'S TRAINING MANUAL, INERT GAS PROCESS. 144 pp. Kaiser Aluminum & Chemical Sales, Inc., 919 N. Michigan Ave., Chicago 11. $1.00.

RECIRCULATION, BULLETIN PFM-110. 12 pp. Cooling Tower Institute, 420 Emerson St., Palo Alto, Calif., $1.00.

DIMENSIONS AND TOLERANCES FOR LIGHT WEIGHT RIGID ABS PLASTIC PIPE, TS-5425. H. A. Bonnet, Commodity Standards Div., U. S. Dept. of Commerce, Washington 25, D. C.

MANUAL OF ACCIDENT PREVENTION IN CONSTRUCTION; SCAFFOLDING LADDERS. 32 pp. Associated General Contractors of America, Inc., 20th and E Sts., N. W., Washington 6, D. C. 15c.

MANUAL OF ACCIDENT PREVENTION IN CONSTRUCTION; EXPLOSIVES, POWDER ACTUATED TOOLS. 21 pp. Associated General Contractors of America, Inc., 20th and E Sts., N. W., Washington 6, D. C. 15c.



Monarch

NOZZLES for AIR WASHERS

These are "non-clogging" nozzles with a single large tangential lead hole to the swirl chamber that will never clog from any impurities small enough to pass through the orifice. Swirl chamber is conical on both ends and pivots liquid like a top to produce an exceptionally fine, evenly distributed, balanced spray of about 80° included angle. Wider spray angles up to 130° can be furnished to order.
Standard material Brass. Also available in Stainless Steel and Monel. Pipe sizes from 1/8" to 1". 1/4" size is 1-5/16" long and made from 5/8" square stock.

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PHILADELPHIA 34, PA.
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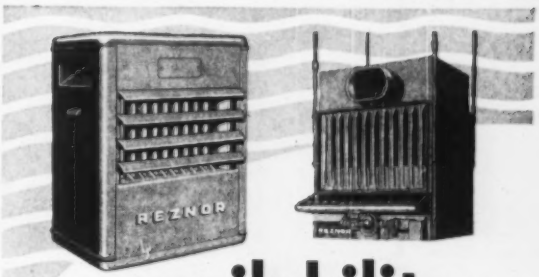
E. S. Gallagher Sales Ltd., Toronto 12, Canada



availability

When you specify Reznor gas heaters, you can do so with confidence that the equipment you call for will be available when it's needed, anywhere in the country. Substantial stocks of all the most frequently used models (both unit heaters and duct furnaces) are maintained by Reznor distributors in more than 200 cities. And if the units you call for don't happen to be available from distributor stocks, shipments from the factory can be made to meet any reasonable schedule.

AVAILABILITY is just one of many reasons why Reznor is right for a wide variety of commercial and industrial buildings. Ask your Reznor distributor for details or write for your free copy of "Modern Heating".

Look for Reznor under "Heaters-Unit" in the Yellow Pages

REZNOR
WORLD'S LARGEST SELLING DIRECT-FIRED
UNIT HEATERS

Reznor Manufacturing Company, 51 Union Street, Mercer, Pa.

√ Check your needs . . .

- ☐ *Personnel*
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- ☐ *Lines, etc.*

Whatever your needs in any of the above classifications . . . you can solve them quickly with a classified advertisement. The space rates are reasonable and results are quick. Closing date—the tenth of the month preceding issue.

KEY-TITE®

Lubricates while it seals

KEY-TITE speeds pipe joint assembly, prevents leakage in water, gas, and low-pressure lines — lubricates while it seals.

New Improved Formula contains special ingredients that increase pliability and open-can life.

Easy to Apply — goes on with a brush — won't crumble or break-off.

Easy to Break — never freezes joints — protects threads.

Safe — assures purity of potable liquids — contains no toxic ingredients.

Order KEY-TITE from your supplier or send for FREE SAMPLE.

KT-5804

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ACCURATE

TEMPERATURE

READINGS

- Hot Water Systems
- Floors, Walls, Ceilings
- Refrigerated Coils
- Insulation
- All Other Low Temps.

You can accurately read any low surface temperature with the Alnor Type 2300 Surface Pyrometer—in 3 to 5 seconds.

Take this rugged, portable instrument to any job in the field and see how performance to laboratory standards can save invaluable time in balancing out a system...save the money lost on call-backs. Large 6″ mirrored scale is direct reading, no conversion...no errors in readings ..1° per division. Precision jeweled movement is protected against abuses of portable service by sturdy walnut case. Comes complete with matched thermocouple and lead ready to use on your next trip out. Send for Bulletin 4257 and get the complete story on the full line of Alnor Pyrometers. Just tear out this ad and mail on your letterhead to: Illinois Testing Laboratories, Inc., Room 513, 420 N. LaSalle St., Chicago 10, Ill.

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PRECISION INSTRUMENTS FOR EVERY INDUSTRY

NEW BOOKS & REPORTS *Continued*

RIGID ABS PLASTIC PIPE, IPS DIMENSIONS, TS-5123. H. A. Bonnet, Commodity Standards Div., U. S. Dept. of Commerce, Washington 25, D. C.

HYGIENIC GUIDES—Covering the handling of 62 separate materials. American Industrial Hygiene Association, 14125 Prevost, Detroit. 25c ea.

DIMENSIONS AND TOLERANCES FOR LIGHT WEIGHT RIGID ABS PLASTIC PIPE, TS-5125. H. A. Bonnet, Commodity Standards Div., U. S. Dept. of Commerce, Washington 25, D. C.

A REPORT ON SPRAYED ROOF COOLING SYSTEMS—By Sam M. Blount, Jr. 30 pp. Industrial Experimental Program, School of Engineering, North Carolina State College, Raleigh, N. C. 25c. ≠

Obituaries

Robert W. Nelson

ROBERT WALLACE NELSON, 48, vice president of American Air Filter Co., died suddenly October 9, 1958, while at work. Mr. Nelson was a former president of the Air Moving and Conditioning Association and a member of the American Society of Heating and Air Conditioning Engineers. A native of Moline, Ill., he was graduated from Culver (Ind.) Military Academy and attended the University of Illinois and the University of Pennsylvania, where he was a member of Delta Tau Delta Fraternity. In 1939 he joined the Herman Nelson Corp. in Moline and was a vice president when it merged in 1950 with American Air Filter. He was executive assistant to the director of sales until 1956 when he became director of the company's central administrative staff.

Clyde E. Weatherwax

CLYDE E. WEATHERWAX, chairman of the board and one of the founders of Acme Industries, Jackson, Mich., died October 13, 1958, at Jackson at the age of 76. Mr. Weatherwax, with his two brothers, founded the company in 1919 as a pipe coil manufacturer. He remained active in the affairs of the company until his death. He is survived by his son, Kenneth A. Weatherwax, company president, and his grandson, Peter A. Weatherwax, executive vice president.

"it's reached for time and time again all year long!"

THE JANUARY DIRECTORY NUMBER OF HEATING, PIPING & AIR CONDITIONING

Each year over 300 advertisers use the January Directory Number to make sure their product story "gets through" when buying decisions are being made, sources of supply investigated. Will you be among them in 1959?

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Look Better — Last Longer

Superior workmanship and finish in heavy-gauge metal assures installations of lasting beauty. Most designs stamped in any thickness, up to one-fourth inch, from any metal. Catalog No. 36 illustrates all designs and gives complete working data. Free on request.

Diamond Manufacturing Co.

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Manufacturers, also, of DIAMONTEX, the Perforated Metal Lay-In Panel for Modern Acoustical Ceilings.

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Representation in New Mexico and West Texas for Heating and Air Conditioning Manufacturers.

A new firm is being established by a Registered Engineer, with ten years experience, to promote the sale of heating and air conditioning equipment to Mechanical Contractors. Only exclusive representation will be considered. If interested write to P. O. Box 3083, El Paso, Texas.

LINES WANTED — Minneapolis Manufacturer's Agent needs one or two additional lines, established 11 years, two registered mechanical engineers on staff, contacts consulting engineers, industrials and mechanical contractors. Address Key 1378A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

. . . after the city, before the state, the ZONE keeps your mail from being late.

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The products include axial flow and tubeaxial fans, both direct and belt driven, and power roof ventilators. Please reply Key 1361A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

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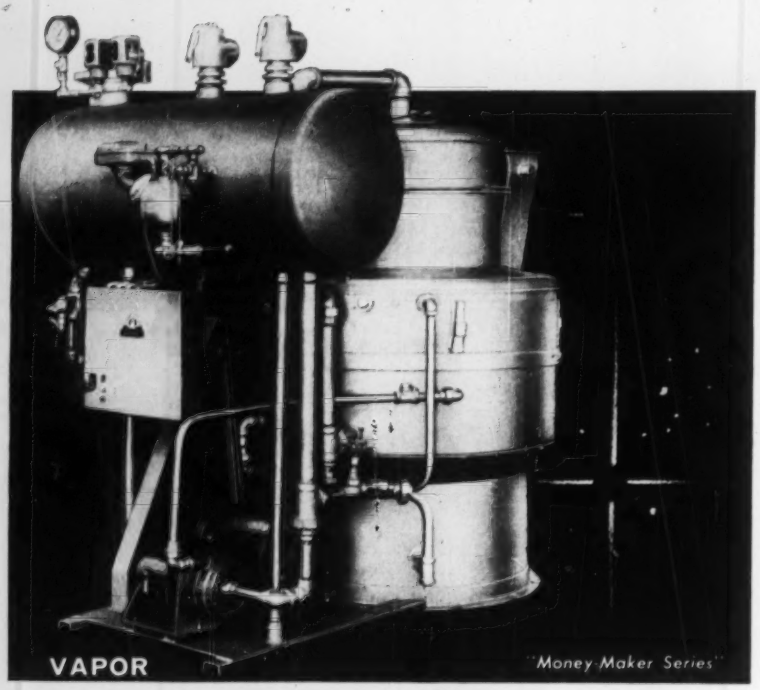

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"FOR QUALITY, ECONOMY AND SERVICE, I'LL PICK SPANG STEEL PIPE EVERY TIME"

says Mr. Anthony A. Madonna, Owner of Twin Arc Welding Company, Lancaster, Pennsylvania

"I know from experience that when I use SPANG Steel Pipe I'm getting a top-quality product," states Mr. Madonna. "Another thing, on the $206,000 heating contract for the Conestoga Valley High School, SPANG's Distributor—Raub Supply Co. of Lancaster, Pa.—made sure we had all the pipe at the job site before construction began. That's the kind of service I like—fast, reliable, economical."

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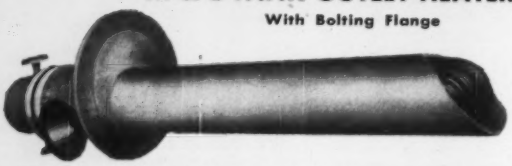

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If you would like your name listed on our records for inquiries we may receive on your territory, we invite you to write us. There is no charge in connection with this service.

Heating, Piping & Air Conditioning
6 North Michigan Avenue Chicago 2, Ill.

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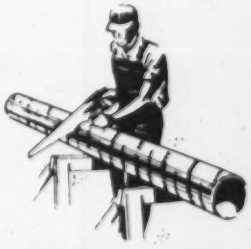

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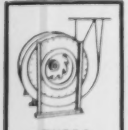

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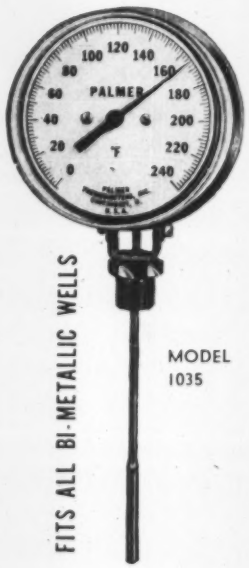

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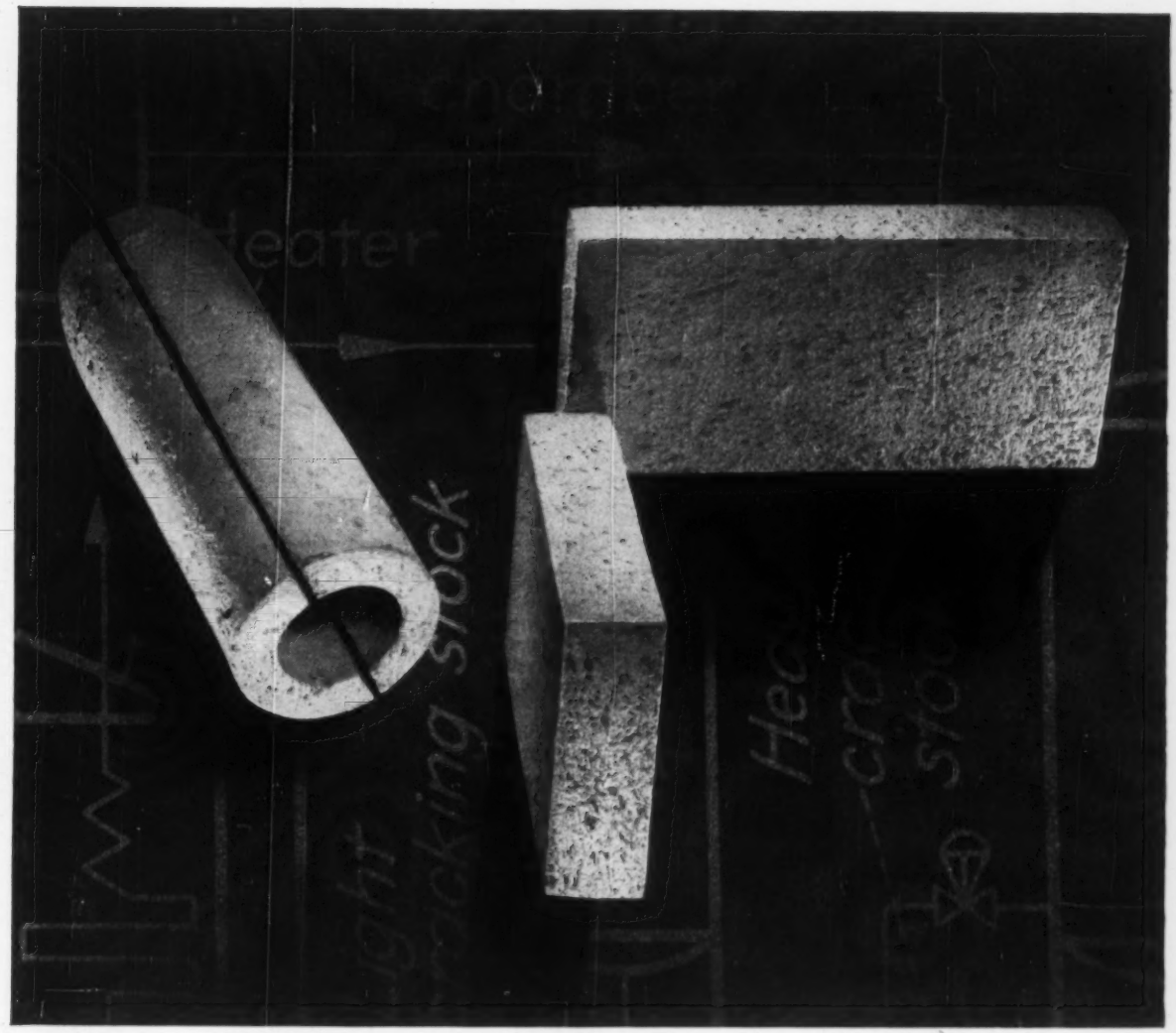

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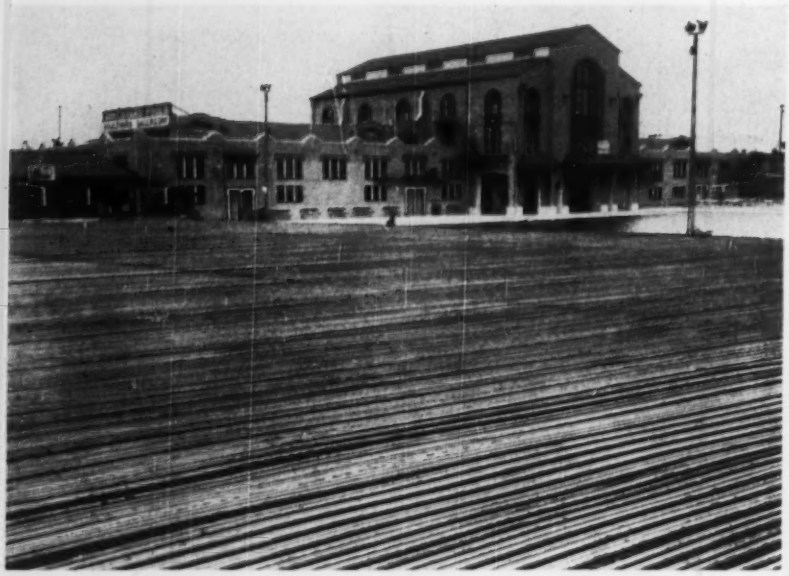

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